OWNERSHIP OF THE EARTH FOREVER AND EVER: ENGINEERING NATURE, RACE, AND LABOR IN SOUTHERN AFRICA AND NORTH AMERICA, 1860-1924

BY

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DISSERTATION

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Abstract

This dissertation considers the networks, methods, and practices of a group of mining engineers active in Canada, the United States, and South Africa in the late-nineteenth- and early-twentieth century mining engineers to map new geographies of racial capitalism, settler colonialism, and territories of extraction. By tracing the careers of these mining engineers, most from the United States, I show that as embodiments of "white extractivism," mining engineers were instrumental to establishing and furthering imperial regimes.

Using archival material from Canada, South Africa, the United Kingdom, and the United States, as well as many engineering periodicals, I argue that although engineers' prescriptions were cloaked in scientific reason, in fact engineers were fortified by faith in whiteness and hypermasculinity as a means to master both the earth and workers. Mining engineers viewed the earth and the people living upon it were nothing more than problems suited to mechanical and "objective" solutions. In practice, as I show, mining engineers set in motion a process of slow violence and differential exposure to death on a vast scale. Nevertheless, these attempts at mastery were subject to challenge, disruption, and unintended consequences at every turn.

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Introduction: Mining Engineers and White Extractivism

> Now men demand that the rich earth provide
> more than the crops and sustenance it owes,
> and piercing to the bowels of the earth,
> the wealth long hidden in Stygian gloom
> is excavated and induces evil;
> for iron, which is harmful, and the more
> pernicious gold (now first produced) create
> grim warfare, which has need of both; now arms
> are grasped in bloodstained hands; men live off plunder
>
> —Ovid, *Metamorphoses*

On June 29th, 1892, Kentuckian mining engineer Hennen Jennings "delivered an excellent inaugural address" at the inaugural meeting of the South African Association of Engineers and Architects.[1] Addressing his fellow "gentlemen," Jennings thought it "well" that such a society be formed in the "comparatively unexploited" Transvaal. Jennings noted that the industry most of the men present were connected with—he did not need to mention mining by name—was "an industry which in the world's history is notable as the most potent pioneer in the development of a new country, and an enormous stimulus to colonization."[2] This dissertation examines and elaborates on the claim that Jennings made about colonization in 1892 and considers the networks, methods, and practices of a group of mining engineers active in Canada, the United States, and South Africa in order to map new geographies of racial capitalism, settler colonialism, and extraction in the late-nineteenth and early twentieth centuries. While it is now commonplace to see North American settler colonialism as one whole object or process, including both Canada and the United States, the same cannot be said of

[1] "Items from Johannesburg," *Port Elizabeth Telegraph*, July 2, 1892.
[2] "Inaugural Address of Mr. Hennen Jennings, President," *Proceedings of the South African Association of Engineers and Architects*, June 29, 1892, 1, 1–2.

South Africa. By tracing the careers of mining engineers, this dissertation demonstrates that all three settler states were bound up in a shared process of settler colonialism.

Mining engineers are usefully characterized as "boundary objects" in that they cohere as a unified whole while also being connected to outside objects.[3] They seem to be nowhere if not in between: between capital and labor, workers and professionals, scientists and technicians, and given their mobility, in between nation-states and empires, not to mention their attendant historiographies. This indeterminate position goes a long way toward explaining their relative absence from historical writing and social theory. It goes a long way to explaining their own anxieties as well, as we will see. Although engineers adopted a "technocratic pose" putatively outside of the political, this dissertation will demonstrate that mining engineers were leaders in shaping "racialized geosocial formations" in Canada, the United States, and southern Africa.[4]

Fundamental to this epistemic community of engineers was what Kathryn Yusoff has termed "White Geology:" a "category and praxis of dispossession" in which persons are transformed into things. More specifically, Yusoff argues that White Geology is a mechanism that makes Blackness coeval with inanimate matter.[5] Historians have yet to illustrate how this practice played out on the ground, however. To see this close up, this dissertation turns to mining engineers who, as applied scientists, were indispensable to White Geology's practice. Just as there has long been commonality between scientists—who, before the nineteenth

[3] On "boundary objects" see Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out: Classification and Its Consequences* (Cambridge, MA: MIT Press, 1999), 15–16, 285–317.
[4] Ken Alder, *Engineering the Revolution: Arms and Enlightenment in France, 1763-1815* (Princeton, NJ: Princeton University Press, 1997), 296; Kathryn Yusoff, "Geologic Realism: On the Beach of Geologic Time," *Social Text* 37, no. 1 (March 2019), 3.
[5] Kathryn Yusoff, *A Billion Black Anthropocenes or None* (Minneapolis: University of Minnesota Press, 2018), 67.

century, were known instead as natural philosophers—who produce knowledge about the natural world, and engineers, who design and make things, there was significant professional overlap between geologists and mining engineers in this period.[6] Mining engineers were nevertheless steeped in geological science and primarily saw it as their professional mission to apply geology at extractive sites around the planet, all in the service of capital. Mining engineers had two primary responsibilities: the design and operation of the mine itself and management of the labor that made extraction possible. John Hays Hammond is instructive on both fronts. Referring to his time working for the imperialist and mining capitalist Cecil Rhodes in South Africa, Hammond recalled the violent compulsion enforced at the mines, where Hammond found "it was frequently necessary to resort to flogging to maintain order among the boys in the compounds. Afterwards the natives would come to the managers and thank them, as a dog crawls to lick the hand of its master after a deserved whipping."[7] In a similar vein, Hammond credited the creation of "machine civilization" to "the engineer," who "exploits the resources of the earth."[8] Unremarked upon by Hammond, it was the combination of engineers' masculinity and whiteness that lent them the authority to master both nature and people. In short, this was how what I term "white extractivism" functioned.

It follows, then, that mining engineers were instrumental to establishing and furthering imperial regimes, a fact that Jennings recognized and celebrated in 1892. Indeed, mineral

[6] Standard treatments credit Cambridge University mineralogist William Whewell with creating the distinction between "natural philosopher" and "scientist" in 1834. David Philip Miller, "The Story of '*Scientist*': The Story of a Word,'" *Annals of Science* 74, no. 4 (2017): 255–61. For a survey of the US context, see Paul Lucier, "The Professional and the Scientist in Nineteenth-Century America," *Isis* 100, no. 4 (December 2009): 699–732. For the development of geology, see Rachel Laudan, *From Mineralogy to Geology: The Foundations of a Science, 1650-1830* (Chicago: University of Chicago Press, 1987).
[7] John Hays Hammond, *The Autobiography of John Hays Hammond* (New York: Farrar and Rinehart, 1935), 1:305.
[8] Hammond, *Autobiography*, 2:735.

extraction has long been recognized as fundamental to imperialism, a relationship which first registered on a global scale at least as far back as 1545, when Spanish imperialists discovered a massive deposit of silver at Potosí, in present-day Bolivia.[9] As historian and nephew of a mining engineer Eric Hobsbawm wrote, "mines were the major pioneers in opening up the world to imperialism."[10] Still, historical accounts of the enjoined processes modernity and empire have not recognized the pivotal role of mining engineers in these processes. While there is some evidence that engineers played an equivalent role outside of US and European empires, this dissertation will focus specifically on white settler colonialism.[11]

Despite the efforts mining engineers made in their attempt to simultaneously control workers and subjugate the nonhuman world, those struggles always remained partial and incomplete. In different ways, both domains were constantly exceeding and eluding the material and intellectual grasp of engineers. Owing to their opposition to organized labor in the US West, as well as their role in advancing empire, mining engineers and managers at times "became marked men."[12] John Hays Hammond recalled an incident from his time in late 1870s Arizona, where he narrowly missed one of the "numerous bands of roving Apaches who were unreconciled to the invasion of the white men." An attack on his party, he wrote, "would not

[9] Kris Lane, *Potosí: The Silver City That Changed the World* (Oakland: University of California Press, 2019).
[10] Eric Hobsbawm, *The Age of Empire: 1875-1914* (New York: Vintage, 1989 [1987]), 2, 63.
[11] This is an underdeveloped avenue of inquiry, but see Limin Teh, "Labor Control and Mobility in Japanese-Controlled Fushun Coalmine (China), 1907–1932," *International Review of Social History* 60, no. S1 (December 2015): 95–119. On the role of empire, geology, and mining in shaping Chinese state formation in this period, see Shellen Xiao Wu, *Empires of Coal: Fueling China's Entry into the Modern World Order, 1860-1920* (Stanford, CA: Stanford University Press, 2015).
[12] Clark C. Spence, *Mining Engineers and the American West: The Lace-Boot Brigade, 1849-1933* (Moscow: University of Idaho Press, 1993), 184.

have been much out of the ordinary."[13] Also in Arizona in 1880, another mining engineer arrived to inspect a mine amid ongoing labor unrest and was taken hostage by miners outraged at not having received their pay.[14] Their connection to empire, too, could mark mining engineers as enemies, as in Chihuahua, Mexico in 1916, when eighteen US mining engineers and one manager were first taunted and then massacred aboard a train on orders from one of revolutionary Pancho Villa's lieutenants.[15] More broadly, I build on the work of anticolonial thinkers like C. L. R. James, who recognized that "Negroes have continually revolted," from the Haitian Revolution to the mass movement of the Industrial and Commercial Workers Union in 1920s South Africa.[16] While contemporary capitalists and engineers, and some historians, continue to refer to a "labor crisis" of African workers on the mines during the South African War of 1899-1902, Donald Denoon has helpfully argued that this should instead be considered a reasoned and concerted decision to withhold labor.[17] Moreover, Antoinette Burton reminds us that labor action could reflect opposition to imperial rule.[18] These relations were always contested.

The nonhuman world—composed of rock, air, water, fire, among much else—likewise refused to do as it was supposed to or as engineers wanted. Environmental historians have by now firmly dismantled urban planner and historian Lewis Mumford's contention that the mine

[13] Indeed, Apache had been resisting displacement and forced labor in mines since the seventeenth century. See Paul Conrad, *The Apache Diaspora: Four Centuries of Displacement and Survival* (Philadelphia: University of Pennsylvania Press, 2021), 47–78. Hammond, *Autobiography*, 1:76.
[14] Spence, *Mining Engineers and the American West*, 123.
[15] Friedrich Katz, *The Life and Times of Pancho Villa* (Stanford, CA: Stanford University Press, 1998), 557–60.
[16] C. L. R. James, *A History of Pan-African Revolt* (Oakland, CA: PM Press, 2012), 38, 85.
[17] D. J. N. Denoon, "The Transvaal Labour Crisis, 1901—6," *Journal of African History* 8, no. 03 (November 1967): 486.
[18] Antoinette Burton, *The Trouble with Empire: Challenges to Modern British Imperialism* (New York: Oxford University Press, 2015), 125.

was the "first completely inorganic environment to be created and lived in by man."[19] More generally, environmental historians and other scholars of the new materialism have shown that the human and nonhuman worlds cannot be separated.[20] Timothy Mitchell's concept of "techno-politics" is indispensable here in understanding how the nonhuman world resists human intervention: "Techno-politics is always a technical body, an alloy that must emerge from a process of manufacture whose ingredients are both human and nonhuman, both intentional and not, and in which the intentional or the human is *always somewhat overrun by the unintended*."[21] Too often when mining engineers designed a solution for a given problem, new ones emerged: toxic mine waste generated in increasingly larger quantities, rising heat at subterranean depths, groundwater rushing in as shafts were sunk deeper, or collapsing underground shafts. Rodents and reptiles, too, were common presences underground. At least one mining engineer was sickened for months by a venomous Gila monster in Mexico.[22] These

[19] Lewis Mumford, *Technics and Civilization* (Chicago: University of Chicago Press, 2010 [1934]), 69; Timothy LeCain, *Mass Destruction: The Men and Giant Mines That Wired America and Scarred the Planet* (Piscataway, NJ: Rutgers University Press, 2009, 18–21. For a critical appraisal of Mumford's environmentalism, see Aaron Sachs, "Lewis Mumford's Urbanism and the Problem of Environmental Modernity," *Environmental History* 21, no. 4 (October 2016): 638–59.

[20] Some important work on the "new materialism" see Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, NC: Duke University Press, 2010); Mel Y. Chen, *Animacies: Biopolitics, Racial Mattering, and Queer Affect* (Durham, NC: Duke University Press, 2012); Samantha Frost, *Biocultural Creatures: Toward a New Theory of the Human* (Durham, NC: Duke University Press, 2016); Zoe Todd, "An Indigenous Feminist's Take on the Ontological Turn: 'Ontology' is Just Another Word For Colonialism," *Journal of Historical* Sociology (March 2016): 4–22; Yusoff, "Geologic Realism;" Joshua Bennett, *Being Property Once Myself: Blackness and the End of Man* (Cambridge, MA: Belknap Press, 2020); Zakiyyah Iman Jackson, *Becoming Human: Matter and Meaning in an Antiblack World* (New York: NYU Press, 2020). Two useful essays that think through materialism and history are Julia Adeney Thomas, "Not Yet Far Enough," *American Historical Review* 117, no. 3 (June 2012): 794–803; Kenneth Lipartito, "Reassembling the Economic: New Departures in Historical Materialism," *American Historical Review* 121, no. 1 (February 2016): 101–39.

[21] Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002), 42–43. Emphasis mine.

[22] Spence, *Mining Engineers and the American West*, 123.

elements of unruly nature, which posed bodily threats to mining engineers themselves, not to mention so many others, demanded a rationalization and a defense.

This constantly failed and failing attempt at mastery goes a long way toward accounting for the fragile, defensive, and assertive quality of the white masculinity performed by mining engineers. After all, engineers could never completely control colonized men held to be effeminate, or the natural world held to be "female." It is gender rather than race that has attracted the most analysis from historians of mining engineers. Indeed, historians commonly resort to superlatives to describe their performances of masculinity: engineering students in Colorado were taught to hold the "belief that the professional mining engineer should be the epitome of nineteenth-century masculinity," while writers commonly depicted mining engineers as the "very personification of manliness."[23] In the 1860s and 1870s, mining engineers like Rossiter Raymond professed an affection for the beauty of the landscape that engineers were simultaneously dismantling. As Timothy LeCain shows, mining engineers began to hide this "feminine" affection for nature, eventually embracing "the modern dichotomous view that split the technological from the environmental, the human from the wilderness, and even the male from the female."[24] Comparing themselves to other occupations that became increasingly professionalized in the late-nineteenth-century United States, "many engineers felt misunderstood, disrespected, and undervalued." In response, as Ruth Oldenziel has shown, an ideal of manliness that emphasized the body and individual achievement, most apparent in sport, came to define engineers just as they began to leave the shop floor and came to occupy

[23] LeCain, *Mass Destruction*, 56; Spence, *Mining Engineers and the American West*, 318.
[24] LeCain, *Mass Destruction*, 55–61.

managerial positions in ever-larger organizations in US society. Masculinity, too, was wielded as a weapon in mining engineers' opposition to organized labor.[25] This was evident in Rossiter Raymond's questioning of the male individuality and domestic responsibilities of the leader of the United Mine Workers of America, but gender took on a colonial dimension in South Africa.[26] Although it was not put into practice, Hammond floated a plan to Rhodes to have the wives of male migrant laborers move closer to the mines, where the women could be "civilized," and their resulting consumer desires would ensure a more reliable labor force.[27] Of course, masculinity and whiteness were deeply entangled. For instance, US mining engineers frequently brought their wives with them when they moved to mining sites, many living opulent but circumscribed lives—a means to protect their femininity and whiteness from racial others, as Radhika Mohanram has shown.[28]

One commonality between engineers and whiteness was that, as Warwick Anderson argues, whiteness operated as a "boundary subject"—this is, embodied in people rather than abstract categories—an adaptable, flexible quality that allowed whiteness to be "the most sensitive marker or tracer of social stress and anxiety in settler nations and colonies."[29] Over and over, mining engineers themselves performed what Anderson has elsewhere described as a

[25] Ruth Oldenziel, *Making Technology Masculine: Men, Women and Modern Machines in America, 1870-1945* (Amsterdam: Amsterdam University Press, 1999), 51, 61, 112.
[26] Some key examples of this large historiography include Teresa Barnes "'So that a labourer could live with his family': overlooked factors in social and economic strife in urban colonial Zimbabwe, 1945–1952, *Journal of Southern African Studies*, 21, no. 1, (March 1995), 95–113; T. Dunbar Moodie and Vivienne Ndatshe, *Going for Gold: Men, Mines, and Migration* (Berkeley: University of California Press, 1994); Ian Phimister and Alfred Tembo, "A Zambian Town in Colonial Zimbabwe: The 1964 'Wangi Kolia' Strike," *International Review of Social History* 60, no. S1 (December 2015): 41–62.
[27] Hammond, *Autobiography*, 1:304–5.
[28] Radhika Mohanram, *Imperial White: Race, Diaspora, and the British Empire* (Minneapolis: University of Minnesota Press, 2007), 43.
[29] Warwick Anderson, "Traveling White," in *Re-Orienting Whiteness*, ed. Leigh Boucher, Jane Carey, and Katherine Ellinghaus (New York: Palgrave Macmillan, 2009), 66.

"virile, energetic whiteness."[30] This dissertation brings together scholarship on whiteness from histories of race and labor in the United States and new elaborations on the concept emerging out of imperial history and Indigenous studies to show that whiteness—functioning as what this dissertation terms white extractivism—was indispensable to enjoined processes of extraction, racialization, and settler colonialism. Following Angela Woollacott, this dissertation offers through its multi-sited, transimperial framing an opportunity to historicize whiteness, and by showing how it changed in time and place, unsettle whiteness rather than reinscribe it.[31] W. E. B. Du Bois recognized in 1920 that the (false) promise of whiteness was "ownership of the earth forever and ever." Du Bois cautioned that the "title to the universe claimed by White Folk" was "faulty" but he recognized that it was global, and exhibited most forcefully in the colonies, where racialized labor was cheap and "the earth is rich."[32] More than historicizing whiteness, however, this dissertation follows Du Bois and Yusoff, and understands race as a modality through which white extractivism operates.[33]

Likewise, race connects land, the earth, and colonialism, as Aileen Moreton-Robinson writes: "the possessive logics of patriarchal white sovereignty and the disavowal of Indigenous sovereignty are inextricably linked, anchored, and regulated through race."[34] In his foundational

[30] Warwick Anderson, *The Cultivation of Whiteness: Science, Health and Racial Destiny in Australia* (Carlton, Vic.: Melbourne University Press, 2002), 6.
[31] Angela Woollacott, "Whiteness and 'the Imperial Turn,'" in *Re-Orienting Whiteness*, ed. Leigh Boucher, Jane Carey, and Katherine Ellinghaus (New York: Palgrave Macmillan, 2009), 18–19. On this point, also see Aileen Moreton-Robinson, Maryrose Casey, and Fiona Nicoll, eds., *Transnational Whiteness Matters* (Lanham, MD: Lexington Books, 2008).
[32] W. E. B. Du Bois, *Darkwater: Voices from Within the Veil* (New York: Harcourt, Brace, and Howe, 1920), 30–31, 45.
[33] Kathryn Yusoff, "The Inhumanities," *Annals of the American Association of Geographers* 111, no. 3 (2020): 663–76.
[34] Aileen Moreton-Robinson, *The White Possessive: Property, Power, and Indigenous Sovereignty* (Minneapolis: University of Minnesota Press, 2015), 192.

definition of settler colonialism, Patrick Wolfe wrote that "settler colonialism seeks to replace the natives on their land rather than extract surplus value by mixing their labor with a colony's natural resources," supplemented with a subordinated and imported labor force.[35] In practical terms, mining engineers were essential to this process: they claimed and were frequently held to be world experts in the managing and recruitment of that labor, and in the material process of getting those resources out of the ground at the lowest possible working cost per ton of ore—the standard by which the professional mining engineer lived and died. If, following Corey Ross, we reconceive colonialism as "not so much as a social project with ecological consequences, but as a socio-ecological project (or better: series of projects) in and of itself," we can see through engineers that the ecological and material aspects of colonialism were bound up with its raced, gendered, and economic ones.[36]

Alongside their ecological impact, mining engineers made singular contributions to the character of capitalism in this period. Indeed, they built on a long history of "coercive labor systems and the coloniality of power as mining technologies" that dates back to at least the sixteenth century.[37] While Cedric Robinson has shown that capitalism was always *racial* capitalism, historians have begun to trace how this concept circulated around the world.[38]

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[35] Patrick Wolfe, "Land, Labor, and Difference: Elementary Structures of Race," *American Historical Review* 106, no. 3 (June 2001), 868.

[36] Corey Ross, *Ecology and Power in the Age of Empire: Europe and the Transformation of the Tropical World* (Oxford: Oxford University Press, 2017), 4.

[37] 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), 8.

[38] Kris Manjapra, "Plantation Dispossessions: The Global Travel of Agricultural Racial Capitalism," in *American Capitalism: New Histories* ed. Sven Beckert and Christine Desan (New York: Columbia University Press, 2018): 361–87; Zach Sell, *Trouble of the World: Slavery and Empire in the Age of Capital* (Chapel Hill: University of North Carolina Press, 2021). Walter Johnson's definition of racial capitalism helps us understand the full gamut of what racial capitalism means when he writes that racial capitalism should be understood as "the intertwined history of white supremacist ideology and the practices of empire, extraction, and exploitation." As a process, racial capitalism is "dynamic, unstable, ever-changing, and world-making." Johnson, *The Broken Heart of America: St.*

Thinking about the relationship between capitalism and engineering dates to at least Thorstein Veblen's 1919 *The Engineers and the Price System*. When historians and social theorists have analyzed the role of engineers, the most common focus is on *mechanical* engineers like Alfred Taylor and Harrington Emerson.[39] For instance, Yehouda Shenhav has powerfully shown that late-nineteenth-century US managerialism was based on the contested concept of rationality, itself developed by US mechanical engineers' understanding of abstract systems. Accordingly, Shenhav argues that engineers were the visionaries behind the managerial revolution of the late nineteenth and early twentieth centuries.[40] Yet, as mining engineers were so far removed geographically from mine owners—who could often be a continent away—they had even more independence to organize and systematize operations than their contemporaries in mechanical and industrial engineering. Combined with the fact that mining engineers were often managers of mine laborers, mining engineers were in the fore of putting ideas about "efficiency" and scientific management to use, both in the US and abroad.[41] As David Roediger and Elizabeth Esch have shown, in practice this meant "race management," wherein mining labor was composed of mixed racial and ethnic groups.[42] Engineers were therefore essential to furnishing and extricating the racial element of capitalism that capitalism has depended on to exploit the

Louis and the Violent History of the United States (New York: Basic Books, 2020), 6. On the connection between antiblackness and Indianness in producing racial capitalism and settler colonialism, see Jodi A. Byrd, "Beast of America: Sovereignty and the Wildness of Objects," *South Atlantic Quarterly* 117, no. 3 (July 2018): 599–615.

[39] Veblen's 1919 essays are collected in Thorstein Veblen, *The Engineers and the Price System* (New York: B. W. Huebsch, 1921).

[40] Yehouda A. Shenhav, *Manufacturing Rationality: The Engineering Foundations of the Managerial Revolution* (Oxford: Oxford University Press, 1999), 18.

[41] On "efficiency" and labor management, see Jennifer Karns Alexander, *The Mantra of Efficiency: From Waterwheel to Social Control* (Baltimore: Johns Hopkins University Press, 2008), 64–68. On scientific management's roots on US plantations, see Caitlin Rosenthal, *Accounting for Slavery: Masters and Management* (Cambridge, MA: Harvard University Press, 2018), 199–204.

[42] David R. Roediger and Elizabeth D. Esch, *The Production of Difference: Race and the Management of Labor in U.S. History* (New York: Oxford University Press, 2012), 86–97, 114–21.

planet's resources. In short, these networks of mining engineers make visible the preconditions for the current world of extractive capitalism that, in the third decade of the twenty-first century, are now truly *planetary* in scale.[43]

National and Comparative Historiographies

This dissertation did not begin by looking for engineers, however, but rather it began as an attempt to build on the comparative historiography of the United States and South Africa by demonstrating that two of the most racially unequal countries on earth could not be easily or neatly analyzed apart from one another.[44] While in fact it is difficult to find a time in which historians did *not* write about the US and its relation to South Africa—which stretches back to the colonial historiography of the early nineteenth century, and later, George Theal—in the last half century it was arguably Sterling Stuckey who, in the midst of struggles for desegregation in 1969, first called for historians to pursue "cross cultural studies of the emergence and impact of

[43] On the "racial subsidies" that capitalism depends on, see Achille Mbembe, *Critique of Black Reason*, trans. Laurent Dubois (Durham, NC: Duke University Press, 2017), 179. On the planetarity of extraction in the twenty first century, see Martín Arboleda, *Planetary Mine: Territories of Extraction Under Late Capitalism* (London: Verso, 2020), 5.

[44] George M. Fredrickson, *White Supremacy: A Comparative Study of American and South African History* (New York: Oxford University Press, 1981); George M. Fredrickson, *Black Liberation: A Comparative History of Black Ideologies in the United States and South Africa* (Oxford: Oxford University Press, 1995); James O. Gump, *The Dust Rose Like Smoke: The Subjugation of the Zulu and the Sioux* (Lincoln: University of Nebraska Press, 1994). William Beinart and Peter Coates, *Environment and History: The Taming of Nature in the USA and South Africa* (London: Routledge, 1995); Pamela E. Brooks, *Boycotts, Buses, and Passes: Black Women's Resistance in the U.S. South and South Africa* (Amherst: University of Massachusetts Press, 2008); John Whitson Cell, *The Highest Stage of White Supremacy: The Origins of Segregation in South Africa and the American South* (Cambridge: Cambridge University Press, 1982); Ivan Evans, *Cultures of Violence: Lynching and Racial Killing in South Africa and the American South* (Manchester: Manchester University Press, 2009); Stanley B. Greenberg, *Race and State in Capitalist Development: Studies on South Africa, Alabama, Northern Ireland and Israel* (New Haven, CT: Yale University Press, 1980); Howard R. Lamar and Leonard Thompson, *The Frontier in History: North America and Southern Africa Compared* (New Haven, CT: Yale University Press, 1981); Shula Marks, Hilary Sapire, and Rick Halpern, eds., *Beyond White Supremacy: Towards A New Agenda For The Comparative Histories Of South Africa And The United States*, Collected Seminar Papers, no. 49 (London: University of London, School of Advanced Study, Institute of Commonwealth Studies, 1997); Christoph Strobel, *The Testing Grounds of Modern Empire: The Making of Colonial Racial Order in the American Ohio Country and the South African Eastern Cape, 1770s-1850s* (New York: Peter Lang, 2007); Anthony W. Marx, *Making Race and Nation: A Comparison of South Africa, the United States, and Brazil* (Cambridge: Cambridge University Press, 1998).

segregationist thought and practices in Rhodesia, South Africa and the United States." These inquiries, Stuckey imagined, could take the form of "comparative studies of segregation in cities, say Johannesburg and Birmingham, Salisbury and Montgomery, Dakar and New York."[45] More recently, over the last two decades, in line with the "transnational" and "global" turns in historiography, comparative approaches that are nationally bounded and are bounded by the nation-state paradigm of historical writing have rightly fallen out of favor.[46] In fact, some comparative practitioners recognized this very problem: John Cell wrote that comparing segregation in the US South and South Africa was an "more than an interesting academic exercise," given that the two cases "were historically connected."[47] Recognition of these influences has produced a flood of recent work that connects the US and South Africa in many periods and forms. Notably, a considerable amount of that scholarship has been influenced by the earlier comparative work.[48] Nevertheless, even as some excellent new global histories of

[45] Sterling Stuckey, "Contours of Black Studies: The Dimension of African and Afro-American Relationships," *Massachusetts Review* 10, no. 4 (Autumn 1969): 747–56; On colonial historiography, see Christoph Strobel, "'The History of the Cape Is Already Written in That of America': The Colonization of America in South Africa's Discourse of Empire, 1820s-1850s," *Safundi* 6, no. 4 (October 2005): 1–15.

[46] This is an enormous literature but for the transnational turn's problem for comparative history, see Micol Seigel, "Beyond Compare: Comparative Method after the Transnational Turn," *Radical History Review* 91, no. 1 (Winter 2005): 62–90.

[47] Cell, *Highest Stage of White Supremacy*, 192.

[48] James T. Campbell, *Songs of Zion: The African Methodist Episcopal Church in the United States and South Africa* (Chapel Hill: University of North Carolina Press, 1995); James T. Campbell, *Middle Passages: African American Journeys to Africa, 1787-2005* (New York: Penguin, 2006); James T. Campbell, "The Americanization of South Africa," in *Race, Nation, and Empire in American History*, ed. James T. Campbell, Matthew Pratt Guterl, and Robert G. Lee (Chapel Hill: University of North Carolina Press, 2007), 130–56; Zoe L. Hyman, "American Segregationist Ideology and White Southern Africa, 1948-1975" (DPhil thesis, University of Sussex, 2011); Zoe Hyman, "Transatlantic White Supremacy: American Segregationists and International Racism after Civil Rights," in *Global White Nationalism: From Apartheid to Trump*, ed. Daniel Geary, Camilla Schofield, and Jennifer Sutton (Manchester: Manchester University Press, 2020), 187–228; Nicholas Grant, *Winning Our Freedoms Together: African Americans and Apartheid, 1945–1960* (Chapel Hill: University of North Carolina Press, 2017); Peter Cole, *Dockworker Power: Race and Activism in Durban and the San Francisco Bay Area* (Urbana: University of Illinois Press, 2018); Zine Magubane, "The American Construction of the Poor White Problem in South Africa," *South Atlantic Quarterly* 107, no. 4 (Fall 2008): 691–713; Carl H. Nightingale, *Segregation: A Global History of Divided Cities* (Chicago: University of Chicago Press, 2012); Robert Trent Vinson, *The Americans Are Coming!: Dreams of African American Liberation in Segregationist South Africa* (Athens: Ohio University Press, 2012); Tiffany

touching on South Africa mention US mining engineers in passing, and comment on their significance, we still lack a full understanding of how South African racial capitalism built from a US model.[49] Significantly, the very concept of "racial capitalism" emerged in the context of the anti-apartheid struggle in the UK, influencing the thought of Cedric Robinson and Stuart Hall. Answering the question of where the origins of South African racial capitalism lie through the story of US mining engineers is one of the central contributions of this dissertation. Just as Robinson and Hall did, this dissertation, too, builds on the now often neglected radical historiography centered on South Africa written during the 1970s and 80s.

Measured against the standard of the rapid and dynamic changes to southern African society wrought by the "mineral revolution"—without parallel anywhere on the globe during the age of empire—the growth of industrialized silver and gold mining in northeastern Ontario in the early twentieth century may seem worth of little more than a footnote to the global history of gold or capitalism. Yet, the people and minerals of the Laurentian Plateau—that extensive area of Precambrian rock that separates eastern and western Canada and forms the geologic basis of the North American continent—have an outsized role in the global history of mining and extractive capitalism, even as they have been seldom considered by historians inside and especially outside of Canada.

Willoughby-Herard, *Waste of a White Skin: The Carnegie Corporation and the Racial Logic of White Vulnerability* (Oakland: University of California Press, 2015); Andrew Offenburger, *Frontiers in the Gilded Age: Adventure, Capitalism, and Dispossession from Southern Africa to the U.S.-Mexican Borderlands, 1880-1917* (New Haven, CT: Yale University Press, 2019); Lynn M. Thomas, *Beneath the Surface: A Transnational History of Skin Lighteners* (Durham, NC: Duke University Press, 2020); Douglas R. Jones, "'The League Will Not Ignore the Cry of the Negro Race for Justice': Marcus Garvey, the League of Nations and South-West Africa," *Journal of Southern African Studies* 48, no. 1 (February 2022): 103–17.

[49] Willoughby-Herard, *Waste of a White Skin*, comes closest to this. Elizabeth Esch, *The Color Line and the Assembly Line: Managing Race in the Ford Empire* (Oakland: University of California Press, 2018), 155; Keith Breckenridge, *Biometric State: The Global Politics of Identification and Surveillance in South Africa, 1850 to the Present* (New York: Cambridge University Press, 2014), 60.

At a global scale of analysis, the massive movement of people, animals, materials, and capital in pursuit of gold has understandably been at the center of so much of globally oriented histories of gold. Accordingly, most comparative and global histories of gold end with what popular Canadian historian Pierre Berton has called the "last great gold rush": the Klondike gold rush of 1896-1899.[50] The Klondike was broadly the last rush where individual prospectors had any chance of striking it rich on their own, giving way to an emergent industrialized, capitalized, and bureaucratized order. By the turn of the century, the ostensibly heroic age of the mining engineer had not yet ended, but in retrospect, men like Hammond or Herbert Hoover had already made their name and their fortune, never to be overshadowed in the field of mining engineering. This emphasis on dramatic mass migration has meant that Ontario's mining history has yet to be analyzed in a global context, nor written into the global history of gold or mining.

While the major mineral finds in northeastern Ontario took place just after this turn of the century shift, it is instructive that even the Klondike Gold Rush is commonly written about as though it were not a Canadian event, despite taking place in what is now Yukon, Canada.[51] As US environmental historian William Cronon has noted, "Although it should by rights be more a Canadian story than an American one—the Klondike is, after all, in Yukon Territory—the movement of US citizens into the Canadian Far North was so enormous that history books usually commit a temporary act of narrative imperialism by annexing the Yukon to the United States just long enough to tell this story."[52] This "act of narrative imperialism" is symptomatic of

[50] Pierre Berton, *The Klondike Fever: The Last Great Gold Rush, 1896-1899* (New York: Alfred A. Knopf, 1958).
[51] Yukon was known as Yukon Territory until 2002 and is still commonly referred to as such.
[52] William Cronon, foreword to Kathryn Morse, *The Nature of Gold: An Environmental History of the Klondike Gold Rush* (Seattle: University of Washington Press, 2003).

the fact that while steps have been taken by some historians, Canada in general has not been considered in global histories of the nineteenth and twentieth centuries.

As this dissertation connects Canada to southern Africa and the United States, it also contributes to historical writing on global histories of race and empire. Although to some extent Canada has figured into recent writing on settler colonialism, Canada largely remains estranged from global histories of race or globally-oriented histories of southern Africa.[53] There are, to be sure, some models and some exceptions, including Kornel Chang's work on white labor activism in western Canada and the United States, and Ikuko Asaka's work which extends African American history north to Canada and south to the Caribbean.[54] Nevertheless, nothing like the comparative and transnational historiography on race connecting the United States, South Africa and Canada as covered in the introduction of this dissertation exists. In fact, although Canada's role as a model for apartheid is sometimes part of Canadian folklore, one historian

[53] In recent years, the *Journal of Settler Colonial* Studies has published a considerable number of articles pertaining to Canada and which situate Canada in a larger settler colonial context. Also see Scott Lauria Morgensen, *Spaces Between Us: Queer Settler Colonialism and Indigenous Decolonization* (Minneapolis: University of Minnesota Press, 2011); Christopher Lloyd, Jacob Metzer, and Richard Sutch, eds., *Settler Economies in World History* (Leiden: Brill, 2013); Annie E. Coombes, ed., *Rethinking Settler Colonialism: History and Memory in Australia, Canada, Aotearoa New Zealand and South Africa* (Manchester: Manchester University Press, 2006); Iyko Day, "Being or Nothingness: Indigeneity, Antiblackness, and Settler Colonial Critique," *Critical Ethnic Studies* 1, no. 2 (Fall 2015): 102–21; Iyko Day, "Settler Colonial Critique, Transnational Lessons," *Verge: Studies in Global Asias* 5, no. 1 (Spring 2019): 2–11. By contrast, Canada does not figure into Patrick Wolfe, "Settler Colonialism and the Elimination of the Native," *Journal of Genocide Research* 8, no. 4 (2006): 387–409 or Wolfe's more extensive *Traces of History: Elementary Structures of Race* (London: Verso, 2016). Canada is present but arguably peripheral in Katherine Ellinghaus, Jane Carey, and Leigh Boucher, eds., *Re-Orienting Whiteness* (New York: Palgrave Macmillan, 2009); Aileen Moreton-Robinson, Maryrose Casey, and Fiona Nicoll, eds., *Transnational Whiteness Matters* (Lanham, MD: Lexington Books, 2008). A notable exception is some of the essays in Karen Dubinsky, Adele Perry, and Henry Yu, eds., *Within and Without the Nation: Canadian History as Transnational History* (Toronto: University of Toronto Press, 2015).

[54] Kornel Chang, "Circulating Race and Empire: Transnational Labor Activism and the Politics of Anti-Asian Agitation in the Anglo-American Pacific World, 1880–1910," *Journal of American History* 96, no. 3 (December 2009): 678–701; Chang, *Pacific Connections: The Making of the U.S.-Canadian Borderlands* (Berkeley: University of California Press, 2012); Ikuko Asaka, "'Our Brethren In The West Indies': Self-Emancipated People In Canada and The Antebellum Politics Of Diaspora And Empire," *Journal of African American History* 97, no. 3 (July 2012): 219–39; Asaka, *Tropical Freedom: Climate, Settler Colonialism, and Black Exclusion in the Age of Emancipation* (Durham, NC: Duke University Press, 2017).

recently concluded that "there is little historical evidence that there was, or could have been, a direct link in the construction of racial policy in Canada and in South Africa."[55] While Horwitz allows that there is value to considering imperial networks, as Ann Laura Stoler and Fred Cooper argued in *Tensions of Empire*, she argues that "there is no evidence of individual colonial agents traveling between Canada and South Africa during the early part of the twentieth century nor is there evidence of any specific, direct communications between the two colonies."[56]

There were, of course, many other connections, as well as *forms* of connections, between the two countries and beyond, even if no government agents exchanged notes. As many historians have shown with increasing force and clarity over the last two decades, Canada was deeply entangled in the "British world."[57] John Darwin and others have called attention to how Canada formed the heart of a "British world" in the late nineteenth century, even as nationalist historians of the "ex-'white dominions'" have ignored those connections.[58] This dissertation eschews the category of the "British world," however, which has rightly been the

[55] Simonne Horwitz, "'Apartheid in a Parka'? Roots and Longevity of the Canada–South Africa Comparison," *Safundi* 17, no. 4 (October 2016), 460. Also see Joan G. Fairweather, *A Common Hunger: Land Rights in Canada and South Africa* (Calgary: University of Calgary Press, 2006); Simonne Horwitz and Dwight Newman, "A Legal-historical Consideration of Links between Canadian and South African Racial Policies," *Commonwealth Law Bulletin* 36, no. 4 (December 2010): 691–706.
[56] Horwitz, "'Apartheid in a Parka'?," 462. Frederick Cooper and Ann Laura Stoler, eds., *Tensions of Empire: Colonial Cultures in a Bourgeois World* (Berkeley: University of California Press, 1997).
[57] Adele Perry, *On the Edge of Empire: Gender, Race, and the Making of British Columbia, 1849-1871* (Toronto: University of Toronto Press, 2001); Kurt Korneski, "Britishness, Canadianness, Class, and Race: Winnipeg and the British World, 1880s-1910s," *Journal of Canadian Studies* 41, no. 1 (Spring 2007): 161–84. For a critique of much of this vein of writing, see Antoinette Burton, "Getting Outside of the Global: Repositioning British Imperialism in World History," in *Empire in Question: Reading, Writing, and Teaching British Imperialism* (Durham, NC: Duke University Press, 2011), 275–92.
[58] John Darwin, *The Empire Project: The Rise and Fall of the British World-System, 1830-1970* (Cambridge: Cambridge University Press, 2009), 177.

subject of criticism.[59] While "Britain and the world" may be an improvement, this dissertation go beyond that conceptually and archivally.[60] US, Canadian, and South African historical writing has in some ways been bound up—often in deeply colonial ways—since the late nineteenth century. To take one notable example, the "father of South African historiography," George McCall Theal, was a descendant of Loyalists and born in New Brunswick.[61] In *Notes on Canada and South Africa*, Theal claimed that while he had never met any Indigenous people in Canada, his expertise on black South Africans was enough to supplement what he read, and in any case, "In ferocity of disposition and disregard of the value of human life the Indian and the Bushman were alike."[62] As Christopher Saunders has shown, Theal was likely influenced by Parkman's conservative reading of indigenous North American history, meaning that these historiographies have long been tangled up in problematic ways. Perhaps because it is not seen as sufficiently transnational to merit study, historical scholarship that considers the US and Canada in a transnational frame is surprisingly underdeveloped.[63]

[59] Rachel K. Bright and Andrew R. Dilley, "After the British World," *Historical Journal* 60, no. 2 (June 2017): 547–68.
[60] Tehila Sasson et al., "Britain and the World: A New Field?," *Journal of British Studies* 57, no. 4 (October 2018): 677–708.
[61] Christopher Saunders, *The Making of the South African Past: Major Historians on Race and Class* (Cape Town: David Philip, 1988), 29. For more on Theal's imperial connections to Canada and South Africa, see Deryck Schreuder, "The Imperial Historian as 'Colonial Nationalist': George McCall Theal and the Making of South African History," in *Studies in British Imperial History: Essays in Honour of A.P. Thornton*, ed. Gordon Martel (Houndmills, UK: Macmillan, 1986), 95–158.
[62] G. M. Theal, *Notes on Canada and South Africa* (Cape Town: Dennis Edwards, 1910), 8–9.
[63] Edward P. Kohn, *This Kindred People: Canadian-American Relations and the Anglo-Saxon Idea, 1895-1903* (Montreal: McGill-Queen's University Press, 2004). Some works that do consider these connections include Paige Raibmon, "Theatres of Contact: The Kwakwa̱ka̱'wakw Meet Colonialism in British Columbia and at the Chicago World's Fair," *Canadian Historical Review* 81, no. 2 (June 2000): 157–90; Nayan Shah, *Stranger Intimacy: Contesting Race, Sexuality, and the Law in the North American West* (Berkeley: University of California Press, 2011).

Although Toronto is now one of the globe's central hubs of mining capital and expertise, it has received little attention as such, and even less from historians.[64] To mining capitalists, however, this is common knowledge. As the same *Engineering and Mining Journal* T. A. Rickard once edited and catalogued the triumphs of US mining engineers recently noted in a report on "Mining in Ontario and Toronto's Global Reach," "Toronto remains the global investment engine of the mining industry through its stock exchanges, mining-focused financial services, consultants, legal advisors and banks that have a long history of financing projects from early-stage exploration through to production."[65]

This dissertation puts these three national historiographies in a single expansive global-imperial frame. As such, it uses mineral extraction to brings together empirically and historically the histories of race, indigeneity, and settler colonialism that remain cleaved apart. This cleavage is in part because, as Robin D. G. Kelley has shown, of an ongoing refusal to consider Africans as indigenous to Africa and South Africa as part of the transnational phenomenon of settler colonialism.[66]

[64] For two exceptions see Paula Butler, *Colonial Extractions: Race and Canadian Mining in Contemporary Africa* (Toronto: University of Toronto Press, 2015); Alain Deneault and William Sacher, *Imperial Canada Inc: Legal Haven of Choice for the World's Mining Industries*, trans. Fred A. Reed and Robin Philpot (Vancouver: Talonbooks, 2012).
[65] "Toronto: The Home of Mining Finance," *Engineering and Mining Journal*, April 2020, 52.
[66] As Kelley writes of the work of Patrick Wolfe, "the exclusion of southern Africa and similar social formations from the definition of settler colonialism not only obscures its global and transnational character but also *eliminates the settler* from African history." Robin D. G. Kelley, "The Rest of Us: Rethinking Settler and Native," *American Quarterly* 69, no. 2 (2017): 269. One important exception is the work of Thiven Reddy, who argues that "South Africa serves as the paradigmatic case" of settler colonialism. Reddy, *South Africa: Settler Colonialism and the Failures of Liberal Democracy* (London: Zed Books, 2015), 9.

Mining Engineer Historiography

Mining engineers—especially from the United States—have themselves recently been the subject of increasing attention from historians.[67] The boldest but most accurate assessment of their importance comes from David Roediger and Elizabeth Esch's history of race management in the United States, which finds that mining engineers "conquered the world for informal U.S. empire after 1890."[68] Nevertheless, only two book-length studies have been written that center on the US: Clark Spence's *Lace-Boot Brigade: Mining Engineers and the American West* originally published in 1970, and Sarah Grossman's *Mining the Borderlands* in 2018. Stephen Tuffnell's 2015 article in the *Journal of Global History* remains the best articulation of the global dimensions of mining engineering. Jessica Teisch's 2011 *Engineering Nature* is a valuable consideration of the global environmental entanglements of US (and in

[67] John Higginson, "Privileging the Machines: American Engineers, Indentured Chinese and White Workers in South Africa's Deep-Level Gold Mines, 1902–1907," *International Review of Social History* 52, no. 01 (April 2007): 1–34; Elaine Katz, "The Contributions of American Mining Engineers and Technologies to the Witwatersrand Gold Mining Industry, 1890-1910," *South African Journal of Economic History* 20, no. 2 (2005): 48–82; Jeremy Mouat, "Engineering Changes: The Cause and Consequence of Modern Mining Methods at Butte, Montana; Johannesburg, South Africa; and Broken Hill, New South Wales," in *Making Sense of Mining History: Themes and Agendas*, ed. Stefan Berger and Peter Alexander (Abingdon, UK: Routledge, 2020), 65–87; Eric C. Nystrom, *Seeing Underground: Maps, Models, and Mining Engineering in America* (Reno: University of Nevada Press, 2014); Jessica B. Teisch, *Engineering Nature: Water, Development, and the Global Spread of American Environmental Expertise* (Chapel Hill: University of North Carolina Press, 2011); Sarah E. M. Grossman, *Mining the Borderlands: Industry, Capital, and the Emergence of Engineers in the Southwest Territories, 1855-1910* (Reno: University of Nevada Press, 2018); Charles van Onselen, *The Cowboy Capitalist: John Hays Hammond, the American West, and the Jameson Raid in South Africa* (Johannesburg: Jonathan Ball, 2017); Mark Hendrickson, "'The Sesame That Opens The Door of Trade:' John Hays Hammond and Foreign Direct Investment in Mining, 1880-1920," *Journal of the Gilded Age and Progressive Era* 16, no. 3 (July 2017): 325–46; Mark Hendrickson, "Advance Agent of Expanding Empires: George F. Becker and Mineral Exploration in South Africa and the Philippines," *History and Technology* 35, no. 3 (2019): 237–65; Morley Nkosi, *Black Workers, White Supervisors: The Origins of the Labor Structure in South Africa* (Trenton: Africa World Press, 2017); Ian Phimister and Jeremy Mouat, "Mining Engineers and Risk Management: British Overseas Investments, 1894- 1914," *South African Historical Journal* 49, no. 1 (November 2003): 1–26; Spence, *Mining Engineers and the American West*; Stephen Tuffnell, "Engineering Inter-Imperialism: American Miners and the Transformation of Global Mining, 1871–1910," *Journal of Global History* 10, no. 1 (March 2015): 53–76; Stephen Tuffnell, "Engineering Gold Rushes: Engineers and the Mechanics of Global Connectivity," in *A Global History of Gold Rushes*, ed. Benjamin Mountford and Stephen Tuffnell (Oakland: University of California Press, 2018), 229–51.

[68] Roediger and Esch, *Production of Difference*, 15.

particular, Californian) engineers, although only one chapter deals with US engineers in South Africa. Moreover, as this dissertation will show, Teisch misses the mark when concluding that "California engineers failed to implement their model of frontier development in South Africa."[69] Instead, I show how engineers succeeded at implementing quite another model of development.

Although not focused on engineers qua engineers, Charles van Onselen's *Cowboy Capitalist* centers on the story of John Hays Hammond and his involvement in the Jameson Raid of 1895. While van Onselen helpfully reorients the history of US empire toward southern Africa, Hammond has also received the most attention of the US mining engineers, in part because he was among the most self-promoting.[70] Mining engineer and future US president Herbert Hoover has likewise received a good amount of attention. The best analysis of Hoover's race engineering remains John Higginson's article. Still, there much less scholarship on Hoover in the context of South Africa, where he was only tangentially involved.[71] Finally, a recent dissertation and article from Jeffrey Bartos that focuses on the biographies of Hammond, Hoover, and

[69] Jessica B. Teisch, *Engineering Nature: Water, Development, and the Global Spread of American Environmental Expertise* (Chapel Hill: University of North Carolina Press, 2011), 130.
[70] Charles van Onselen, *The Cowboy Capitalist: John Hays Hammond, the American West, and the Jameson Raid in South Africa*, 447–72.
[71] Ron Limbaugh, "Pragmatic Professional: Herbert Hoover's Formative Years as a Mining Engineer, 1895-1908," *Mining History Journal*, 2004, 43–58; Jeremy Mouat and Ian Phimister, "The Engineering of Herbert Hoover," *Pacific Historical Review* 77, no. 4 (November 2008): 553–84; Carroll Pursell, "Herbert Hoover and the Transnational Lives of Engineers," in *Transnational Lives: Biographies of Global Modernity, 1700–Present*, ed. Desley Deacon et al (Houndmills, UK: Palgrave Macmillan, 2010), 109–20.

another US mining engineer, Hennen Jennings, rounds out the recent work.[72] Recent scholarship on engineers in South Africa is even less common.[73]

Engineering as a profession and practice remains vastly understudied by historians, as well as social theorists more broadly. Two works by very well-known thinkers—Bruno Latour and James C. Scott—illustrate the point well. Scott's *Seeing Like a State* is an "account of the logic behind the failure of some of the great utopian social engineering schemes of the twentieth century."[74] Despite the title, Latour's *Science in Action: How to Follow Scientists and Engineers through Society* contains scarcely any discussion of engineers qua engineers. This is a lament shared by many, including Latour.[75]

Where this dissertation differs from this recent work is primarily in its method. The leading comparative historian of his time who did so much to further this field, George Fredrickson, once offered some advice to graduate students wishing to take up comparative history. Fredrickson wrote that "excellent comparative dissertations in the fullest sense […] can

[72] Jeffrey Michael Bartos, "Mining for Empire: Gold, American Engineers, and Transnational Extractive Capitalism, 1889-1914" (PhD dissertation, Montana State University, 2018); Jeffrey Bartos, "The Accumulated Knowledge of a Thousand Generations: U.S. Mining Engineers as Public Intellectuals, 1885–1920," *Technology and Culture* 62, no. 4 (October 2021): 1172–98.

[73] J. Ralph Draper, *The Engineer's Contribution: A History of the South African Institution of Mechanical Engineers* (Johannesburg: Kelvin House, 1967); John Lang, *Bullion Johannesburg: Men, Mines and the Challenge of Conflict* (Johannesburg: Jonathan Ball, 1986).

[74] James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998), 4.

[75] Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard University Press, 1987), 15. Despite the title, Latour's book contains scarce discussion of engineers. Some notable exceptions include Kees Gispin, *New Profession, Old Order: Engineers and German Society* (Cambridge: Cambridge University Press, 1989); Edward Beatty, *Technology and the Search for Progress in Modern Mexico* (Oakland: University of California Press, 2015); Cara New Daggett, *The Birth of Energy: Fossil Fuels, Thermodynamics, and the Politics of Work* (Durham, NC: Duke University Press, 2019); Aparajith Ramnath, *The Birth of an Indian Profession: Engineers, Industry, and the State, 1900-1947* (Cambridge: Cambridge University Press, 2019); Roderick I. Wilson, *Turbulent Streams: An Environmental History of Japan's Rivers, 1600-1930* (Leiden: Brill, 2021); Owain Lawson, "A National Vocation: Engineering Nature and State in Lebanon's Merchant Republic," *Comparative Studies of South Asia, Africa and the Middle East* 41, no. 1 (May 2021): 71–87.

be done, but [the] difficulties should not be underestimated." Fredrickson himself was "preoccupied with two-sided comparisons because historians can do them with the best effect."[76] Where most work on mining engineers, as well as the racial nomos of the Atlantic world, is grounded in one or, more rarely, two national (or imperial) archives and historiographies, this dissertation is based on archival research conducted in the US, Canada, United Kingdom, and South Africa. It is also, importantly, grounded in US, South African, Canadian, and British imperial historiographies, bringing each to bear on a subject that touches on all of them.

While I borrow from global history and its method, following Sara Ahmed I use the global as an orienting device, and embrace the possibility that it can be *dis*orienting.[77] As Anna Tsing has shown in her ethnography of global connection, those connections can often be messy and surprising.[78] This dissertation makes no pretensions to telling the history of capitalism or the globe through minerals or engineering. More helpful for navigating different scales is Tony Ballantyne's "mobile" method. Ballantyne has described the "profoundly mobile character of racial knowledge and discourses about cultural difference within the British empire, a reality that necessitates a trans-national analysis imperial knowledge production."[79] I

[76] George M. Fredrickson, *The Comparative Imagination: On the History of Racism, Nationalism, and Social Movements* (Berkeley: University of California Press, 1997), 10.
[77] Sara Ahmed, *Queer Phenomenology: Orientations, Objects, Others* (Durham, NC: Duke University Press, 2006), 157–62.
[78] Anna Lowenhaupt Tsing, *Friction: An Ethnography of Global Connection* (Princeton, NJ: Princeton University Press, 2005), 3.
[79] Tony Ballantyne, "Race and the Webs of Empire: Aryanism from India to the Pacific," *Journal of Colonialism and Colonial History* 2, no. 3 (2001).

also follow other transnational and global historians like Lisa Lowe and Tiffany Willoughby-Herard who emphasize Black anticolonial perspectives to critically read archival silences.[80]

Although, as argued above, a strictly comparative method that reinforces national borders and historiographies runs counter to the aims of this dissertation, the insights gained from comparison are worth holding on to.[81] In the spaces opened up by an expansive framework of connections, comparisons nevertheless yield insight.[82]

A Note on Definitions

Race is understood here following Stuart Hall: "race is a cultural and historical, not biological, fact." In other words, Hall argued, "race is a discursive construct, a sliding signifier." Race is "one of those major or master concepts (the masculine form is deliberate) that organize the great classificatory systems of difference that operate in human societies. Race, in this sense, is the centerpiece of a hierarchical system that produces differences."[83] In this lecture series and elsewhere, as in an essay on Gramsci, Hall was always insistent that "one must start […] from the concrete historical 'work' which racism accomplishes under specific historical conditions—as a set of economic, political and ideological practices, of a distinctive kind, concretely articulated with other practices in a social formation."[84] Moreover, Hall argued that,

[80] Lisa Lowe, *The Intimacies of Four Continents* (Durham, NC: Duke University Press, 2015), 74; Tiffany Willoughby-Herard, *Waste of a White Skin: The Carnegie Corporation and the Racial Logic of White Vulnerability* (Oakland: University of California Press, 2015), xv.
[81] One of the clearest expressions of the power of comparisons remains T. Skocpol and M. Somers, "The Uses of Comparative History in Macrosocial Inquiry," *Comparative Studies in Society and History* 22, no. 2 (1980): 174–97.
[82] Andrew Zimmerman, *Alabama in Africa: Booker T. Washington, the German Empire, and the Globalization of the New South* (Princeton, NJ: Princeton University Press, 2010); Lynn M. Thomas, *Beneath the Surface: A Transnational History of Skin Lighteners* (Durham, NC: Duke University Press, 2020), 12.
[83] Hall acknowledged that he was following Du Bois in this articulation. Hall, *The Fateful Triangle: Race, Ethnicity, Nation* (Cambridge, MA: Harvard University Press, 2017), 32–33.
[84] Stuart Hall, "Gramsci's Relevance for the Study of Race and Ethnicity," in *Selected Writings on Race and Difference*, ed. Paul Gilroy and Ruth Wilson Gilmore (Durham, NC: Duke University Press, 2021), 338.

"Unless one attributes to race a single, unitary transhistorical character—such that wherever and whenever it appears it always assumes the same autonomous features, which can be theoretically explained, perhaps, by some general theory of prejudice in human nature (an essentialist argument of a classic type)—then one must deal with the historical specificity of race in the modern world."[85] Accordingly, this dissertation sets out to detail just these "specific historical conditions" as they existed in particular places and times.

Gender, the focus of chapter 2, is understood here as Joan Scott articulated it, as a "useful category of analysis." Defining "gender is a constitutive element of social relationships based on perceived differences between the sexes, and gender is a primary way of signifying relationships of power," Scott called for historians to consider how the categories of gender change over time rather than take them for granted.[86]

Historians Jane Burbank and Frederick Cooper usefully define empires as "large political units, expansionist or with a memory of power extended over space, polities that maintain distinction and hierarchy as they incorporate new people." Where nation-states tend to "homogenize" people within them, "while the empire reaches outward and draws, usually coercively, peoples whose difference is made explicit under its rule. The concept of empire presumes that different peoples within the polity will be governed differently."[87] More pertinently, Adom Getachew has helpfully shown how "black anticolonial critics" such as Kwame Nkrumah, Marcus Garvey, and Du Bois "drew critical attention to the enduring legacy of

[85] Stuart Hall, "Race, Articulation and Societies Structured in Dominance," in *Selected Writings on Race and Difference*, ed. Paul Gilroy and Ruth Wilson Gilmore (Durham, NC: Duke University Press, 2021), 198–99.
[86] Joan W. Scott, "Gender: A Useful Category of Historical Analysis," *American Historical Review* 91, no. 5 (December 1986), 1067.
[87] Jane Burbank and Frederick Cooper, *Empires in World History: Power and the Politics of Difference* (Princeton, NJ: Princeton University Press, 2010), 8.

racial hierarchy and slavery in the making of modern international society." In doing so, Getachew shows, these critics offered a more expansive definition, and "theorized empire as a structure of international racial hierarchy."[88] While Canada, South Africa, and the United States each had origins in the British empire, each also functioned as imperial regimes in this period. Getachew's definition is a useful reminder that the broader transnational effects of white extractivism as practiced by mining engineers had a more general effect, not confined to each nominally "national" imperial formation.

Engineers in this era had no agreed-upon definition of what exactly constituted an engineer. In practice, this dissertation understands engineers as people who claimed to be ones and who were generally regarded by others to be that. As discussed in chapter 1 and 2, the necessity of having an engineering degree only came into effect in roughly the 1890s. Walter Vincenti's definition is among the most useful. Vincenti argues that the most obvious aspect of engineering is that "is a problem-solving activity. Engineers spend their time dealing mostly with practical problems, and engineering knowledge both serves and grows out of this occupation." Where scientists search for understanding without aiming at "rigidly specific goals," engineers "must work to very concrete objectives" requiring "that they devise relevant design criteria and specifications." In Vincenti's view, engineers generally have little use for "phenomenological theories," which "serve almost solely for engineering calculation. Engineers

[88] Adom Getachew, *Worldmaking after Empire: The Rise and Fall of Self-Determination* (Princeton, NJ: Princeton University Press, 2019), 14–36.

devise them because they must get on with their design job and the and the phenomena in question are too poorly understood or too difficult to handle otherwise."[89]

Steven Goldman offers another useful contrast with science: while the "problems that engage scientists are 'there', waiting to be recognized," the problems confronting engineers

> are created by people who *want* to do something specific and are constrained in various ways, to a degree by what nature will allow, but primarily by highly contingent factors that, from a logical as well as a natural perspective, are arbitrary: time, money, markets, vested interests and social, political and personal values. It follows that engineering reasoning in the design process is in a sense 'captive' to the wilfulness underlying the specification of engineering problems and their solutions.[90]

The deeply contingent nature of engineering problems and rationality is one of its most noteworthy features. One of the few historians to attempt to articulate a shared definition of engineering in historical terms, Antoine Picon, argues that "The only common denominator to all the species of engineers that can be found throughout the centuries and in the various domains where actors consider themselves and are considered by others as engineers is perhaps the idea of a specific kind of a reason at work in their endeavours."[91] "Rationality is inseparable from imagination. At the intersection of the two, one finds among others the key notions of effectiveness and efficiency. Contrary to what most engineers postulate in their desire to ground their practice on an indisputable science and on an ahistorical rationality, effectiveness and efficiency are culturally constructed notions."[92]

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[89] Walter G. Vincenti, *What Engineers Know and How They Know It: Analytical Studies from Aeronautical History* (Baltimore: Johns Hopkins University Press, 1990), 200–20.
[90] Steven L. Goldman, "Compromised Exactness and the Rationality of Engineering," in *Social Systems Engineering: The Design of Complexity*, ed. César García-Díaz and Camilo Olaya (Hoboken, NJ: John Wiley & Sons, 2018), 21–22.
[91] Antoine Picon, "Engineers and Engineering History: Problems and Perspectives," *History and Technology* 20, no. 4 (December 2004), 429.
[92] Picon, "Engineers and Engineering History," 431.

Chapter Contents

Chapter 1, "A New Empire of Industry: Mining Capitalism and Science Conjugate White Extractivism," outlines how mining engineering, geologic science, and a new form of corporate capitalism combined at the end of the Reconstruction era in the United States—the 1870s—to form a new "category and praxis of dispossession" in the form of Yusoff's concept of white extractivism.[93] White extractivism constituted the worldview undergirding mining engineers' activities, offering engineers and those they worked for a powerful set of tools as well as the presumptive authority to engineer the earth as well as to manage a racialized mining workforce. This chapter introduces this key concept by looking how the wider developments of geological science, applied science, anthropology, and the end of Reconstruction came together before and during mining engineer Hennen Jennings' time at Harvard University. It looks back in time to consider the influence of Swiss geologist and natural scientist Louis Agassiz and his protégé, noted scientific racist Nathaniel Shaler, whom Jennings overlapped with at Harvard's Lawrence Scientific School. Combining new histories of "science and capitalism" with what Manu Karuka terms "shareholder whiteness"—that post-emancipation change in whiteness wherein it became compatible with corporate and finance capitalism—the chapter attempts to understand how mining engineers turned people into things.[94]

Mining engineers have been recognized as among the greatest exemplars of hegemonic masculinity in a time when imperial modes of masculinity were at a peak. Chapter 2, "Fantasies of Absolute Power: Engineers and White Settler Masculinity," examines the origins of this

[93] Yusoff, *A Billion Black Anthropocenes or None*, 67.
[94] Manu Karuka, *Empire's Tracks: Indigenous Nations, Chinese Workers, and the Transcontinental Railroad* (Oakland: University of California Press, 2019), 150.

defensive and assertive masculinity, identifying its beginnings in romantic imperial fiction, and locating the anxiety in engineers' move from individual, consulting work to a less autonomous role in ever-larger corporate managerial roles. In response, engineers in the North America and southern Africa increasingly attempted to embody and perform their settler masculinity. Risking danger and possessing a virile, able body was increasingly valued. The chapter also describes the highly gendered domestic world of mining engineers—almost exclusively men—and that of their wives who frequently traveled with them and often shouldered many burdens that went largely unrecognized. At bottom, the chapter argues that mining engineer masculinity belies the technocratic and abstracted reasoning engineers themselves gave publicly in defense of their policies. Instead, white settler masculinity goes a long way toward explaining mining engineers' appetite for subjugating the "feminine" earth and its associated colonized and/or racialized workers. In other words, it shows how labor management was a consequence of white male extractivism. Further, the mechanistic and mathematically formalist view of the nonhuman world—into which colonized workers were lumped—that was expressed in engineers' journals, field books, and charts was only possible through a gendered division of the world in which putatively scientific and rational "male" worldviews were opposed to passive and irrational "female" epistemologies. While histories of gender, empire, and imperial markers of difference (i.e., race) are no longer new, connecting those histories to extraction is a pressing concern. In so doing, this chapter brings new meaning to the concept of toxic masculinity.

The third chapter, "Men Who Love a Fight with Nature: Disassembling the Earth in California and South Africa, 1870-1910," focuses on the human and nonhuman interactions that, alongside the managerial and organizational responsibilities, were central to the theory

and praxis of mining engineering. Using examples from the settler colonial sites of the US West and South Africa, I argue that despite the theoretical way in which the nonhuman world was abstracted and subjected to capitalist imperative to growth, the nonhuman world resisted such abstraction. In fact, this was something mining engineers implicitly recognized, but I show how white masculinity was central to concealing and defusing the cognitive dissonance involved in mass destruction. The chapter begins in California in the aftermath of the gold rush, as individual prospectors engaged in placer mining were rapidly replaced by large-scale hydraulic mining, which came with devastating consequences for the environment and brought it into conflict with agricultural capitalism. Carefully avoiding a recapitulation of US exceptionalism while examining its US inflections, the chapter then shows how these practices were globalized by focusing on gold mining on the Witwatersrand and the ecological issues involved in mine waste—particularly what residents described as the "demon dust" that waste produced—produced on an enormous scale. Throughout, the chapter considers the necropolitical dimensions of the "slow violence" enacted by mining engineers, which among other things, contributed to urban racial segregation in Johannesburg and increased rates of respiratory disease among African and Chinese residents.[95]

Next is the first of two chapters considering mining engineers' practice of "race management." The first, "Cornerstone of That New Imperialism: US Mining Engineers and Race Management, 1870-1903," begins in the US West and demonstrates how managerial practices considered race as just one variable in their quest to reduce working costs per ton. Working

[95] On "slow violence" see Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011).

costs per ton were the all-important variable in the capitalist drive to extraction, and the foregoing chapters demonstrate how engineers were able to sacrifice so much on its altar. After a consideration of the continuities and ruptures between pre- and post-emancipation labor regimes, this chapter begins at the New Almaden quicksilver (mercury) mine near San Jose, California. Here, along with the North Bloomfield Hydraulic Gravel Mining Company in Nevada County, California, I identify the origins of the labor component of white extractivism, showing how the quantitative engineering and accounting methods that putatively justified racialized labor recruitment first cohered. Put more directly, extractivism literally created white masculine engineer culture on the backs of laborers of color.

This chapter adds to the work of historians who have largely focused on racial division in the context of Arizona copper mining in the late 1880s through 1910s.[96] I then show how the same individuals who were prominent at the New Almaden mine came to have far more influential roles first at Rothschild-owned mines in Venezuela, and then on the Witwatersrand in southern Africa. As historians like Charles van Onselen have shown how the Jameson Raid had deep resonances with US-style imperial filibustering—in which US adventurers invaded nations the US was formally at peace with, I instead show how US mining engineers like Jennings, Perkins, Hellmann, and others came to shape British imperial policy toward South Africa in the lead up to, and aftermath of, the South African War of 1899-1902.

[96] There is an extensive historiography on this question in Arizona. See Phillip Mellinger, *Race and Labor in Western Copper: The Fight for Equality, 1896 – 1918* (Tucson: University of Arizona Press, 1995); Katherine Benton-Cohen, *Borderline Americans: Racial Division and Labor War in the Arizona Borderlands* (Cambridge, MA: Harvard University Press, 2009); James W. Byrkit, *Forging the Copper Collar: Arizona's Labor Management War of 1901-1921* (Tucson: University of Arizona Press, 1982); Linda Gordon, *The Great Arizona Orphan Abduction* (Cambridge: Harvard University Press, 1999); Phyllis Cancilla Martinelli, *Undermining Race: Ethnic Identities in Arizona Copper Camps, 1880-1920* (Tucson: University of Arizona Press, 2009).

Chapter 5, “Title to the Universe: Race Management and its Discontents, 1903-1924,” picks up where the previous chapter left off with the South African War. Here I consider how mining engineers managerial practices shaped and were shaped by the actions of mineworkers. I begin by reconceiving of the migrant African labor “shortage” of the war as a strike, allowing us to better understand the motivations of African mineworkers and the policy prescriptions a committee of US mining engineers confidentially offered Britain’s Lord Milner as he reshaped South Africa’s social structure between 1903 and 1910. Renowned in the US for their union-busting and race management practices, it is only in the post-Reconstruction context can we understand mining engineers’ calls to import indentured Chinese labor—as had been done in the US South and West—and to cynically call for a workforce of majority African miners on the basis that emancipated enslaved people had proven what black workers could accomplish. The backlash this prompted on the part of white mine workers was enormous, exposing a schism among mining engineers. A small, breakaway element of mining engineers became leaders of white labourism, a movement which lead to a wave of strike action culminating in the 1922 Rand Revolt. In ways that historians of the United States, the British empire, and South Africa have yet to examine, I show that many of the key political and labor conflicts of early twentieth century South Africa—which had continuities far beyond—can be identified in the practices of White Geology. While the chapter focuses on the biggest case—South Africa—it still considers other activity directed against mining engineers, notably the imposition of race management on the mostly white immigrant workforce in northern Ontario and the revolt against it during the First World War. Finally, the conclusion asks what residual elements of mining engineers survived into the age of oil during the short twentieth century and beyond into the twenty-first.

Following these embodiments of white extractivism around the earth is an avenue for articulated new geographies and genealogies of racial capitalism, settler colonialism, alongside new territorialities of extraction that move along, between, and beyond narrowly national or imperial scales. In this, I follow the work of W. E. B. Du Bois, who is the historiographic and intellectual lodestar of this dissertation.[97] The historian Robin D. G. Kelley has argued that Du Bois was "an intellectual whose work contributed more to "internationalizing" American history than perhaps any other historian dead or alive."[98]

Before diving into that history, however, it is worth pausing to reflect on the present. Since 2015, following a movement to decolonize South African universities, the statue of the ultimate imperialist, Cecil Rhodes, no longer towers over the University of Cape Town campus. At the University of Oxford, a related movement is underway to remove Rhodes' statue from Oriel College, of which Rhodes was a significant donor. This is all well and just. Ironically, however, Rhodes and, to a lesser extent, his fellow Randlords, were content to leave the day-to-day operations of their deathly and toxic extractive sites to engineers like Hammond and Jennings. Finally, then, this dissertation is an opportunity to do a more holistic accounting of

[97] In addition to works cited elsewhere, my reading of Du Bois owes much to Cedric J. Robinson, *Black Marxism: The Making of the Black Radical Tradition* (Chapel Hill: University of North Carolina Press, 2000), 185–240; David R. Roediger, *The Wages of Whiteness: Race and the Making of the American Working Class* (London: Verso, 1991), 11–13; Paul Gilroy, *The Black Atlantic: Modernity and Double Consciousness* (London: Verso, 1993), 111–145, Hall, *Fateful Triangle*; Robin D. G. Kelley, "'But a Local Phase of a World Problem': Black History's Global Vision, 1883-1950," *Journal of American History* 86, no. 3 (December 1999): 1045–77; Amy Kaplan, *The Anarchy of Empire in the Making of U.S. Culture* (Cambridge, MA: Harvard University Press, 2002), 171–212; Nikhil Pal Singh, *Black Is a Country: Race and the Unfinished Struggle for Democracy* (Cambridge, MA: Harvard University Press, 2004), 58–100; Lowe, *Intimacies of Four Continents*, 165–73; Nahum Dimitri Chandler, *Toward an African Future—Of the Limit of World* (Albany: SUNY Press, 2013); Nahum Dimitri Chandler, *"Beyond This Narrow Now": Or, Delimitations, of W. E. B. Du Bois* (Durham, NC: Duke University Press, 2022); Gayatri Chakravorty Spivak, "Revisions of Ontology: On Nahum Dimitri Chandler's X—The Problem of the Negro as a Problem for Thought," *Cultural Critique* 111, no. 1 (Spring 2021): 135–55.

[98] Kelley, "But a Local Phase," 1054.

the human and non-human cost of mining capitalism, whose ledgers and statistics externalize humans from the environment and fail to acknowledge what would today be written off as the "externalities" of economic development.[99]

[99] For a brilliant artistic and anthropological attempt to do just this, see William Kentridge and Rosalind C. Morris, *Accounts and Drawings from Underground: East Rand Proprietary Mines Cash Book, 1906* (Calcutta: Seagull Books, 2015). On capitalism as a "way of organizing nature" that sees humans as separate from it, see Jason W. Moore, *Capitalism in the Web of Life: Ecology and the Accumulation of Capital* (London: Verso, 2015), 14.

Chapter 1. A New Empire of Industry: Mining Capitalism and Science Conjugate White Extractivism

> The two great cultural advances of the past century were the Darwinian theory and the development of geology. The one explained how and the other where we live. Compared with such ideas the whole gamut of mechanical and chemical invention pales into a mere matter of current ways and means.
>
> —Aldo Leopold, 1936

This chapter weaves together a number of threads that combined around the 1870s to form what this dissertation terms "white extractivism." In the broadest terms, white extractivism had four principal antecedents: geologic science, capitalism, imperialism, and ideas about human difference. The chapter begins by surveying the role of geology in nineteenth-century empire, focusing on North America and southern Africa, demonstrating how geology was critical to mapping and understanding resources and their profitable extraction. Importantly, it also demonstrates how geology in this period was inseparable from ethnology, paleontology, and debates over the nature of human difference. Turning next to the application of geologic science in midcentury California and Nevada, the chapter lays the groundwork for understanding how a particular group of consulting engineers came to embody these midcentury changes during the period of "Greater Reconstruction."[1] Third, the chapter looks at what Paul Lucier has termed "Comstock Capitalism" and the interrelationship between engineering and managerial and finance capitalism to understand the roots of white extractivism.[2] Finally, the chapter zooms in on Harvard's Lawrence Scientific School, from its origin in 1846 to the turn of the century, to see how these threads combined in practice and up

[1] Elliott West, "Reconstructing Race," *Western Historical Quarterly* 34 (Spring 2003): 7–26; Richard White, *The Republic for Which It Stands: The United States during Reconstruction and the Gilded Age, 1865-1896* (New York: Oxford University Press, 2017), 103–35.
[2] Paul Lucier, "Comstock Capitalism: The Law, the Lode, and the Science," *Osiris* 33, no. 1 (October 2018), 213.

close. Through a consideration of Swiss naturalist Louis Agassiz, scientific racist Nathaniel Shaler, and a number of the mining engineers they trained, such as Thayer Lindsley and especially Hennen Jennings, who was at the very center of white extractivism, we can see how geology, colonialism, racism, and extraction came together.

The United States of the 1870s was above all noteworthy for what Du Bois called the "counter-revolution of property." This was Du Bois' evocative term for the violent overthrow of Reconstruction in the interests of capital, infamously betraying promises to ensure political participation of black southern men. In many ways, historical writing on the United States is still catching up to Du Bois' insights, and this chapter is no exception. In his magisterial *Black Reconstruction in America*, Du Bois correctly understood the material basis of the emergent dictatorship of capital, a ruling style he described as "a new feudalism" that moreover "was destined to crush the small capitalist as ruthlessly as it controlled labor." The end of meaningful democracy in 1876, and the "new industrial empire" that followed, he wrote, were obtained "through the *efficiency of an industrial machine that bought the highest managerial and engineering talent* and used the latest and most effective methods and machines in a field of unequaled raw material and endless market demand."[3] This chapter attempts to understand how that amalgamation of science and capital came together in a novel way in the 1870s. In this way it joins a growing body of scholarship on capitalism and science.[4] Its object, however, is

[3] W. E. B. Du Bois, *Black Reconstruction in America, 1860-1880* (New York: Free Press, 1935), 583–85. Emphasis mine. For an appreciation of how far ahead Du Bois was from the US historical profession at large, see Moon-Ho Jung, "Black Reconstruction and Empire," *South Atlantic Quarterly* 112, no. 3 (Summer 2013): 465–71.

[4] For a recent state of the field survey, see Lukas Rieppel, Eugenia Lean, and William Deringer, "Introduction: The Entangled Histories of Science and Capitalism," *Osiris* 33, no. 1 (October 2018): 1–24. For recent examples in US history, see Courtney Fullilove, *The Profit of the Earth: The Global Seeds of American Agriculture* (Chicago: University of Chicago Press, 2017); Michelle Murphy, *The Economization of Life* (Durham, NC: Duke University Press, 2017); Lukas Rieppel, *Assembling the Dinosaur: Fossil Hunters, Tycoons, and the Making of a Spectacle*

much larger. As Denise Ferreira da Silva has shown, race is foundational to the very idea of a global subjectivity.[5] Accordingly, the "racial calculus" and "political arithmetic" that Saidiya Hartman has shown became entrenched during racial slavery took on new forms in what Hartman calls the "afterlife of slavery." [6] This chapter, then, examines the transformations in "racial calculus" to understand how mining engineers came to believe they had not only the authority to master both people and the earth but also the power to define and redefine the distinction between what is living and what is not. By applying this racial calculus as managers of extractive sites, mining engineers exercised what Elizabeth Povinelli describes as "geontopower:" the separation of Life from Nonlife. As Povinelli writes, this has a particular relation to capitalism, given that "capitalism sees all things as having the potential to create profit; that is, nothing is inherently inert, everything is vital from the point of view of capitalization, and anything can become something more with the right innovative angle."[7] The newly ascendant dictatorship of capital was the ideal place to learn how to exercise geontopower.

Geology, Empire, and Ideas of Human Difference

Geology has come to relatively wide attention in recent years through the concept of the Anthropocene, Paul Crutzen's argument that humans are now acting as a geologic force on

(Cambridge, MA: Harvard University Press, 2019); Emily Pawley, *The Nature of the Future: Agriculture, Science, and Capitalism in the Antebellum North* (Chicago: University of Chicago Press, 2020). The classic account of this period is David F. Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (Oxford: Oxford University Press, 1977).

[5] Denise Ferreira da Silva, *Toward a Global Idea of Race* (Minneapolis: University of Minnesota Press, 2007).

[6] Saidiya Hartman, *Lose Your Mother: A Journey Along the Atlantic Slave Route* (New York: Farrar, Straus and Giroux, 2008), 6.

[7] Elizabeth A. Povinelli, *Geontologies: A Requiem to Late Liberalism* (Durham, NC: Duke University Press, 2016), 1–20.

earth in the form of climate change. Geology has however received little attention from historians of the United States and the British empire.[8] There has been some recent work as part of the material and environmental turn, but nevertheless scholarship on geology in Europe and its colonies largely stopped in the 1980s. This is unfortunate because after geology split from physical geography over the course of a half-century from circa 1780 to 1830, it quickly became a widely practiced science, held in high regard by the scientific community, and consciously implemented as an instrument of territorial expansion. Infused with Baconian rationality, geology's ascent was conveniently timed to a moment when imperial expansion shifted from a focus on territory to a concern with resources, particularly as coal supplanted wood as an energy source.[9] It is worth pausing to consider what it meant for a branch of science to be Baconian and imperial. As an appreciative biographer writes of Francis Bacon (1561-1626), "For Bacon knowledge brought power, and the science he desired was inseparably linked with the conquest and mastery of nature."[10] For a host of thinkers, this desire to harness

[8] Crutzen's argument and associated neologism was first put forth in Paul J. Crutzen, "Geology of Mankind," *Nature* 415 (January 2002): 23. For instance, geology is scarcely present in Richard Drayton, *Nature's Government: Science, Imperial Britain and the 'Improvement' of the World* (New Haven, CT: Yale University Press, 2000); Helen Tilley, *Africa as a Living Laboratory: Empire, Development, and the Problem of Scientific Knowledge, 1870-1950* (Chicago: University of Chicago Press, 2011), and makes only a brief appearance in Saul Dubow, *A Commonwealth of Knowledge: Science, Sensibility, and White South Africa, 1820-2000* (Oxford: Oxford University Press, 2006), 99–100. Contrary to the promise of its title, empire is almost entirely absent from the widely cited Jim Endersby, *Imperial Nature: Joseph Hooker and the Practices of Victorian Science* (Chicago: University of Chicago Press, 2008). One work that deals obliquely with both empire and geology is Crosbie Smith and M. Norton Wise, *Energy and Empire: A Biographical Study of Lord Kelvin* (Cambridge: Cambridge University Press, 1989). In the South Asian context, see Sujaya Sarkar, *The Making of Geology in India: A Historical Study in Science and Colonialism, 1767-1856* (Kolkata: Progressive Publishers, 2016).

[9] Jürgen Osterhammel, *The Transformation of the World: A Global History of the Nineteenth Century*, trans. Patrick Camiller (Princeton, NJ: Princeton University Press, 2014); Shellen Xiao Wu, *Empires of Coal: Fueling China's Entry into the Modern World Order, 1860-1920* (Stanford, CA: Stanford University Press, 2015); On Barak, *Powering Empire: How Coal Made the Middle East and Sparked Global Carbonization* (Oakland: University of California Press, 2020). In the case of the United States empire, see Peter A. Shulman, *Coal and Empire: The Birth of Energy Security in Industrial America* (Baltimore: Johns Hopkins University Press, 2015).

[10] Perez Zagorin, *Francis Bacon* (Princeton, NJ: Princeton University Press, 1998), 121.

inductive reason to the conquest of the nonhuman world has either been a major cause of modernity's blessings or ailments, depending on their point of view.[11] Notably, Baconianism's belief that science was to be used in service of the state was compatible with the prevailing ethos of the industrial revolution and relatedly, the market revolution in the United States and more broadly the age of capital. As importantly, Bacon's ideas are inseparable from gender and empire. As Anne McClintock has shown, "Bacon's vision of a world-knowledge dominated by Europe was animated not only by an imperial geography of power but also by a gendered erotics of knowledge."[12] While it is true that, as Martin Fichman has shown, for Bacon's critics Merchant and William Leiss, "their actual target is the reductionist Baconian model of domination of nature and not Bacon's original ethically informed concept of using knowledge for moderated human material betterment," by the mid-eighteenth century the ethical component of the Baconian imperative had been all but forgotten.[13] The only record of a turn-of-the-century mining engineer taking an interest in Bacon comes from Herbert Hoover, on a summer vacation in Shakespeare's hometown of Stratford, UK. Finding Stratford "intellectually rather dull," Hoover decided to "liven up the mental processes of the neighbors" by boning "up on the Baconian theory" that Francis Bacon was the true identity of the playwright. Hoover

[11] For a defense of Bacon, see Zagorin, 120–28, and more recently Joel Mokyr, *A Culture of Growth: The Origins of the Modern Economy* (Princeton, NJ: Princeton University Press, 2017), 70–98, and for critiques see Theodor W. Adorno and Max Horkheimer, *Dialectic of Enlightenment*, trans. John Cumming (London: Verso, 1973 [1944]); William Leiss, *The Domination of Nature* (Montreal: McGill-Queen's University Press, 1994 [1972]); Carolyn Merchant, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (San Francisco: Harper & Row, 1989 [1980]), 33, inter alia. For an overview of the marginalization of Merchant's *Death of Nature* by historians of early modern science, see Katharine Park, "Women, Gender, and Utopia: *The Death of Nature* and the Historiography of Early Modern Science," *Isis* 97, no. 3 (September 2006): 487–95.

[12] Anne McClintock, *Imperial Leather: Race, Gender, and Sexuality in the Colonial Contest* (New York: Routledge, 1995), 23. Also see Merchant, *Death of Nature*, 80.

[13] Martin Fichman, "Technoscientific Control of Nature: The Ultimate Paradox," *Journal of the History of the Behavioral Sciences* 57, no. 4 (Fall 2021), 416–17.

gleefully wrote that "It took only a little of it to start a cataract of indignant refutation."[14] If mining engineers themselves were ignorant of Bacon, they nevertheless embodied Bacon's vision of wedding science to material and economic gain.

In the early nineteenth century, geology had yet to join biology or paleontology by branching off independent of natural science. Bound together disciplinarily as well as by their shared interest in fossils, they were deeply formed by one another. More than that, however, these sciences were still informed and shaped by humanistic and social scientific thinking.[15] Along with paleontology, geology in particular—the most historical of the sciences—was born through the process of transposing the narrative of human history onto the deep past, using the earth as an archive as Martin Rudwick and David Sepkoski have shown.[16] Geology was never just about rocks.

One of the key outputs of geology as far as white extractivists were concerned was the geologic map, which plotted the location of ore bodies and rock masses, and thereby made legible to imperialists the subterranean depths of the earth.[17] As a Baconian science, fieldwork

[14] Herbert Hoover, *Memoirs of Herbert Hoover: Years of Adventure, 1874-1920* (London: Hollis and Carter, 1952), 122.
[15] Barak, *Powering Empire*, 196–97.
[16] Martin J. S. Rudwick, *Bursting the Limits of Time: The Reconstruction of Geohistory in the Age of Revolution* (Chicago: University of Chicago Press, 2005); Martin J.S. Rudwick, *Worlds Before Adam: The Reconstruction of Geohistory in the Age of Reform* (Chicago: University of Chicago Press, 2008); Martin J.S. Rudwick, *Earth's Deep History: How It Was Discovered and Why It Matters* (Chicago: University of Chicago Press, 2014). David Sepkoski, "The Earth as Archive: Contingency, Narrative, and the History of Life," in *Science in the Archives: Pasts, Presents, Futures*, ed. Lorraine Daston (Chicago: University of Chicago Press, 2017), 53–83; Rieppel, *Assembling the Dinosaur*, 18–20.
[17] Robert A. Stafford, "Geological Surveys, Mineral Discoveries, and British Expansion, 1835–71," *Journal of Imperial and Commonwealth History* 12, no. 3 (May 1984), 5. For more on visual representations of geology, see Martin J. S. Rudwick, "The Emergence of a Visual Language for Geological Science 1760—1840," *History of Science* 14, no. 3 (September 1976): 149–95; Heidi V. Scott, "Taking the Enlightenment Underground: Mining Spaces and Cartographic Representation in the Late Colonial Andes," *Journal of Latin American Geography* 14, no. 3 (2015): 7–34; Nystrom, *Seeing Underground*. The standard general treatment of visuality and engineering remains Eugene S. Ferguson, *Engineering and the Mind's Eye* (Cambridge, MA: MIT Press, 1992).

was essential to geology's process, and so went hand in hand with exploration and territorial expansion, particularly in service of mineral extraction. As Bruce Braun has shown for late nineteenth century Canada, geology was essential to envisioning "a territory that had depth, and whose verticality could be known and represented systematically."[18] It took time for many states to realize that, however, as we will see below.

Werner, Humboldt, and Freiberg's *Bergakademie*

At the turn of the nineteenth century, as mineralogy and physical geography metamorphosed into geology, German states led European and North American states in its state use of geology. In large part, this was due to state investment and intensive state and industry exchange.[19] Until at least midcentury, the *Königliche Sächsische Bergakademie* (Royal Saxon Mining Academy) at Freiberg, Germany, was central to this metamorphosis. Freiberg was home to the "father of German geology," Adolph Gottlob Werner (1749-1817).[20] Recent scholarship is beginning to complicate a long-held focus on Werner's theories of "Neptunism"—the idea that catastrophic events in the earth's history can account for gaps in the fossil record—which left unchallenged Christian ideas about the age of the earth. While these debates were no doubt significant, Sebastien Felten has recently shown how Werner is significant for another reason altogether. Werner, Felten shows, was not simply interested in rock as an epistemic object of the emerging earth sciences but he extracted mine workers' knowledge of rock in an early effort at scientific management in order to lower costs.

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[18] Bruce Braun, "Producing Vertical Territory: Geology and Governmentality in Late Victorian Canada," *Ecumene* 7, no. 1 (2000), 28.
[19] Sebastian Felten, "The History of Science and the History of Bureaucratic Knowledge: Saxon Mining, circa 1770," *History of Science* 56, no. 4 (December 2018): 403–31.
[20] On Werner's theory of "formations" as well as his widespread influence, see Laudan, *From Mineralogy to Geology*, 87–112.

Moreover, this knowledge extraction reinforced distinctions between "scientists" like Werner and workers.[21] These distinctions between professionals and workers, and the former's extraction of the latter's knowledge, constitute an essential component of white extractivism.

Through Werner's student Alexander von Humboldt (1769-1859), and, in turn, Humboldt's protégé, Swiss-born naturalist Louis Agassiz (1807-1873), the influence of Werner and Freiberg had a long life.[22] Humboldt is best known as a German naturalist and explorer, celebrated for his wide-ranging travels from 1799-1804 in the Americas, land masses he described and catalogued in modern scientific terms for the first time. A host of recent scholarship has focused variously on Humboldt's cosmopolitanism, romanticism, and proto-environmentalism. The best exemplar of this is historian Aaron Sachs, who provocatively argues that Humboldt's emphasis on subjectivity and scientific humility are what animate modern environmentalism. As importantly, however, Humboldt and his numerous students, or those who simply swam in what Sachs describes as the "Humboldt Current," as it were, were instrumental to imperial expansion and extraction across the Americas.[23] Humboldt's methods animated exploration and the search for "empty"—that is, free of other settlers—land in the Canadian North and West, known as Rupert's Land, as well as the US West in the early

[21] Sebastien Felten, "Wie Fest Ist Das Gestein? Extraktion von Arbeiterwissen Im Bergbau Des 18. Jahrhunderts," *WerkstattGeschichte* 81 (März 2020): 15–35.

[22] On Humboldt, see Aaron Sachs, *The Humboldt Current: Nineteenth Century Exploration and the Roots of American Environmentalism* (New York: Viking, 2006); Laura Dassow Walls, *The Passage to Cosmos: Alexander von Humboldt and the Shaping of America* (Chicago: University of Chicago Press, 2009); Andrea Wulf, *The Invention of Nature: Alexander von Humboldt's New World* (New York: Knopf, 2015). For more on Humboldt's imperial designs on South America, contra Sachs, see Gregory T. Cushman, *Guano and the Opening of the Pacific World: A Global Ecological History* (New York: Cambridge University Press, 2013), 23–38.

[23] Mary Louise Pratt has shown, for instance, that in the context of early nineteenth century independence movements in South America, Humboldt's ideas could be put to many different uses. Pratt, *Imperial Eyes: Travel Writing and Transculturation* (New York: Routledge, 1992), 111–43. For more on how German scientists supported other imperial regimes, see Moritz von Brescius, *German Science in the Age of Empire: Enterprise, Opportunity and the Schlagintweit Brothers* (Cambridge: Cambridge University Press, 2018).

nineteenth century.[24] As was so often the case, alongside imperial designs, mineral extraction was fundamental to Humboldt's own method, as Patrick Anthony has shown. Before Humboldt's trip to the Americas from 1799 to 1804, it was his devotion to extraction in the service of the Prussian state that most defined his professional identity. As Anthony writes, "the overwhelming emphasis on Humboldt's American journey has marginalized the vital importance of his training at the Mining Academy in Freiberg, Saxony, and led to a general neglect of the fervor for practical knowledge and public utility that captured his allegiance to science in the 1790s."[25] Mining was not simply the means for an income to support scientific research, but as with the case of Werner, powerfully shaped the imperatives of science as well.

The academy at Freiberg functioned as a magnet for aspirant young men from around the world, who were eager to learn its extractive methods. Only some of those young men came primarily for the science, while the rest to came apply it. The town of Freiberg had been a site of functioning mining activity since at least the twelfth century, and its underground "honeycombed with six hundred miles of galleries," making it an ideal school for mining men.[26] A number of US mining engineers like Raphael Pumpelly, known as "the American Humboldt," James D. Hague, Rossiter Raymond, and Hammond sought an education at Freiberg, the oldest mining school in Europe and the central node in the mid-nineteenth-century global network of mining engineers.[27] *Bergakademie* graduates represented the elite tranche of mining

[24] Suzanne Zeller, "Humboldt and the Habitability of Canada's Great Northwest," *Geographical Review* 96, no. 3 (July 2006): 382–98; Sachs, *Humboldt Current*, 187.
[25] Patrick Anthony, "Mining as the Working World of Alexander von Humboldt's Plant Geography and Vertical Cartography," *Isis* 109, no. 1 (March 2018): 28–55.
[26] Raphael Pumpelly, *My Reminiscences* (New York: Henry Holt, 1918), 1:119.
[27] Spence*, Mining Engineers and the American West*, 25. On Frieberg, see Notre Dame database; Spence, *Mining Engineers*, 25–33; Kent A. Curtis, *Gambling on Ore: The Nature of Metal Mining in the United States, 1860-1910* (Boulder: University Press of Colorado, 2013), 83–92.

engineers.[28] Along with two of his Yale classmates, John Hays Hammond set off for Freiberg right after his graduation. As Hammond wrote in his autobiography:

> From the great Werner, father of geology, down to my own time, those eager to extract her secrets and treasures from Mother Earth had turned to Freiberg for instruction; they had sat at the feet of her illustrious Herren Doktoren [Gentlemen Doctors]; under her stimulus they had sallied forth to unlock the hidden places of wealth and bid all nations partake of their abundance. They had learned "to scorn ostentation and live laborious days." Something more than mere intelligence and natural ability drove these pioneers of mineral science to apply their great talents to world-development. Moreover, their rigid training in this old Saxon school bade them prefer the truth and honor of their calling above material considerations.[29]

While Hammond captures some of the appeal of the *Bergakademie*—its illustriousness and world-leading reputation—his claim that its graduates "scorned ostentation" and were motivated by more than lucre rings false in light of his career, as we will see.

One graduate, Canadian-born R. W. Rothwell, was not as well-known as many of his colleagues trained at the *Bergakademie*, but his highly mobile career is very representative. Rothwell began his undergraduate studies at Trinity College in Toronto before shifting to civil engineering at the Rensselaer Polytechnic Instiute in Troy, NY. After graduating in 1858, Rothwell traveled first to the "Imperial School of Mines" in Paris and after two and a half years, left with the degree of Engineer of Mines. From there, he went to the *Bergakademie* to take the "'practical courses' in mining and ore-dressing," and then to London in 1862 "for the purpose of familiarizing himself with business methods." Working for W. T. Henley, a manufacturer of rope and telegraph cables, Rothwell began his career "at the bottom," solely "discharging clerical duties." Upon his return to the United States, Rothwell worked in the anthracite coal fields of

[28] Spence, *Mining Engineers and the American West*, 35.
[29] Hammond, *Autobiography*, 1:63.

Pennsylvania, becoming a founding member of the American Institute of Mining Engineers (AIME).[30]

The fact that Rothwell did not immediately start his career in a lucrative position was not uncommon. "The distinctive feature of Freiberg training," Hammond wrote, was "the division of time between lectures and laboratory work at the university, and field work at the mines."[31] This unique characteristic of the *Bergakademie* set it apart, drawing students from around the world. As Hammond recalled, "Probably no other educational institution in the world had a more cosmopolitan student body: Russians, Englishmen, Americans, Italians, Canadians, South Americans, Mexicans, Japanese, Chinese, Australians, Poles, Austrians, Bohemians—a truly heterogeneous collection of nationalities."[32] This combined training in the science and application of extraction—of the earth and of workers—was what made it foundational to the development of white extractivism.

In Britain and its colonies, however, geology largely remained the province of those men with the means to fund their own fieldwork and scientific research.[33] While there were some individuals like William Smith who had one foot in extraction and one in geology, in scientific terms, British geology in the early nineteenth century came to surpass Werner, obscuring the role of men like Smith.[34] Nowhere was this truer than in the case of Scottish geologist Charles

[30] R. W. Raymond, "Biographical Notice of Richard P. Rothwell, C.E., M.E.," *Transactions of the American Institute of Mining Engineers* 31 (1902): 513–27. For more on Rothwell and the founding of the AIME, see Nystrom, *Seeing Underground*, 57–59.
[31] Hammond, *Autobiography*, 1:66.
[32] Hammond, *Autobiography*, 1:65.
[33] Roy Porter, "Gentlemen and Geology: The Emergence of a Scientific Career, 1660-1920," *Historical Journal* 21, no. 4 (December 1978): 809–36. Also see Roy Porter, *The Making of Geology: Earth Science in Britain, 1660-1815* (Cambridge: Cambridge University Press, 1977); Simon J. Knell, *The Culture of English Geology, 1815-1851: A Science Revealed Through Its Collecting* (Aldershot, UK: Ashgate, 2000); Hugh Torrens, *The Practice of British Geology, 1750–1850* (Aldershot, UK: Ashgate, 2002).
[34] Paul Lucier, "A Plea for Applied Geology," *History of Science* 37, no. 3 (September 1999), 294.

Lyell and his three volume work, *Principles of Geology*, published between 1830 and 1833. Much has been written on Lyell and his influence on Darwin, and it would be hard to understate his influence on geology. In short, Lyell's argument, popularized in his *Principles of Geology*, that the earth was very, very old, revolutionized geology and soon overturned Werner. It also opened up a range of social, political, and theological issues, making it possible for Darwin to conceive of evolution. Lyell cemented geology as a fundamentally *historic* science, and in so doing opened up difficult questions of human difference and polygenism.[35] Lyell's travels in North America in 1841 and 1842 are suggestive of how geologists viewed these questions that pertained to more than the earth's crust.[36] Lyell's conception of slavery and race was that African-descended people were out of joint with the forward movement of time.[37] Along with Roderick Murchison, known as the "King of Siluria" for discovering the Silurian and Permian eras, both did much to put British geology in the lead in global terms.[38] Crucially, they also trained the next generation of geologists, some British and some from the colonies, many of whom would go forth and apply their knowledge to survey, possess, and either settle or extract vast portions of the earth. Arguably this process was most apparent in British North America.

[35] For an overview of these nineteenth century issues in a scientific context, see David N. Livingston, *Adam's Ancestors: Race, Religion, and the Politics of Human Origins* (Baltimore: Johns Hopkins University Press, 2008).
[36] Yusoff, *A Billion Black Anthropocenes or None*, 74–76.
[37] Charles Lyell, *Travels in North America, in the Years 1841-2; with Geological Observations on the United States, Canada, and Nova Scotia*, vol. 1 (New York: Wiley and Putnam, 1845); Charles Lyell, *Principles of Geology; or, The Modern Changes of the Earth and Its Inhabitants*, Ninth (New York: D. Appleton, 1858). For a more general treatment of nineteenth century British views of the past, broadly conceived, see Peter J. Bowler, *The Invention of Progress: The Victorians and the Past* (Oxford: Basil Blackwell, 1989) and Adelene Buckland and Sadiad Qureshi, eds., *Time Travelers: Victorian Encounters with Time and History* (Chicago: University of Chicago Press, 2020).
[38] Robert A. Stafford, *Scientist of Empire: Sir Roderick Murchison, Scientific Exploration and Victorian Imperialism* (Cambridge: Cambridge University Press, 1989).

In Canada, scientific expertise had long been marshaled in the service of various forms of extraction, dating back to the seventeenth century and the Hudson's Bay Company.[39] In Canada, Lyell himself played a role in the geologic surveying of Cape Breton's coalfields.[40] A student of Lyell's, John Dawson, did important work on coal in Nova Scotia, and his son, geologist George Dawson, took a keen interest in ethnography of Indigenous people and geology, and his fieldwork played a key role in opening up Canada's far north to development, laying the groundwork for the Klondike Gold Rush of 1896-1899.[41] Montreal-born geologist and founding director of the Canadian Geological Survey William Logan owed a lot of his knowledge to British geologic science, especially given his education in Scotland. Like many mining engineers, Logan's career began not in geology or engineering but working for his uncle's counting house (an accounting office) in London. From there, in 1831 his uncle sent him to work as a manager of a copper-smelting company in Wales.[42] There, Logan applied mining and metallurgical knowledge he gained from his time in South Wales in 1830s.[43] Logan surveyed the Laurentian Plateau primarily in search of *the* commodity of the nineteenth century—coal—and,

[39] Theodore Binnema, *"Enlightened Zeal": The Hudson's Bay Company and Scientific Networks, 1670-1870* (Toronto: University of Toronto Press, 2014).
[40] For more on Nova Scotia's coal connections to Britain, see Donald Nerbas, "Empire, Colonial Enterprise, and Speculation: Cape Breton's Coal Boom of the 1860s," *Journal of Imperial and Commonwealth History* 46, no. 6 (2018): 1067–95.
[41] Morris Zaslow, *The Opening of the Canadian North* (Toronto: McClelland and Stewart, 1971), 77–100
[42] Christy Vodden, *No Stone Unturned: The First 150 Years of the Geological Survey of Canada* (Energy, Mines and Resources Canada, 1992), 3. For a history of smelting in South Wales in the period Logan was present, see Chris Evans and Louise Miskell, *Swansea Copper: A Global History* (Baltimore: Johns Hopkins University Press, 2020), 78–118.
[43] H.S. Torrens, "William Edmond Logan's Geological Apprenticeship in Britain 1831-1842," *Geoscience Canada* 26, no. 3 (September 1999): 97–110. The standard but also official text on the history of the Geological Survey of Canada is Morris Zaslow, *Reading the Rocks: The Story of the Geological Survey of Canada, 1842-1972* (Macmillan, 1975).

his widely publicized findings were published in 1863 as the *Geology of Canada*.[44] The dissemination of that knowledge did what it was intended to: encourage the Provinces of Canada (present day Ontario and Quebec) to merge with coal-rich Nova Scotia, helping propel the process of Confederation.[45] As Suzanne Zeller writes, "Logan's Laurentian system lent physical backbone and daring vision to a colonial world undergoing profound reconceptualization."[46] It was Murchison who recommended Logan to Canada's Provincial Legislature in the first place.[47]

An ocean away, Murchison's misapprehension of southern African geology meant that although the Cape Colony had been claimed by Britain since 1806, British geologists disregarded the region, convinced that Murchison was correct when he pronounced that the area held no precious metals.[48] British imperial efforts at geological surveying were most pronounced in Canada, India, and Australia rather than the Cape or Natal. There is little scholarship on geology in nineteenth century South Africa, although William Beinart and Saul

[44] Osterhammel, *Transformation of the World*, 651–58. Kenneth Pomeranz argues that coal, along with colonies, was chiefly responsible for the "great divergence" between Europe and Asia. For his treatment of coal, see Kenneth Pomeranz, *The Great Divergence: China, Europe, and the Making of the Modern World Economy* (Princeton, NJ: Princeton University Press, 2000), 59–68.

[45] John William Dawson, *Acadian Geology: The Geological Structure, Organic Remains, and Mineral Resources of Nova Scotia, New Brunswick, and Prince Edward Island* (Edinburgh: Oliver and Boyd, 1855), printed in a second edition the year following Confederation, 1868. For the role of British finance in Canadian confederation, see Andrew Smith, *British Businessmen and Canadian Confederation: Constitution Making in an Era of Anglo-Globalization* (Montreal: McGill-Queen's University Press, 2008). For a recent argument about the British imperial nature of Canadian Confederation, see Peter Price, *Questions of Order: Confederation and the Making of Modern Canada* (Toronto: University of Toronto Press, 2020).

[46] Suzanne Zeller, "The Colonial World as Geological Metaphor: Strata(Gems) of Empire in Victorian Canada," *Osiris* 15 (January 2000), 98. Also see Zeller's fuller but less critical treatment, Suzanne Zeller, *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation* (Toronto: University of Toronto Press, 1987), 94–112.

[47] Archibald Geikie, *Life of Sir Roderick I. Murchison: Based on His Journals and Letters* (London: John Murray, 1875), 368.

[48] Jane Carruthers, "Friedrich Jeppe: Mapping the Transvaal c. 1850–1899," *Journal of Southern African Studies* 29, no. 4 (December 2003), 960–61.

Dubow view the discipline as "a foundational science in South Africa."[49] Ironically, given South Africa's later history, the "father of South African geology," Andrew Geddes Bain, originally had little to do with minerals. Employed by the Royal Engineers Department building roads, in 1837 Bain had a chance encounter with Lyell's *Principles of Geology* and was soon "smitten" with searching for fossils. Bain sent his first finding, "a strange turtle-like skull with a beak and two canine tusks" to the Geological Society of London, which took a great interest and supported Bain's searches with a grant.[50] David Draper was an amateur geologist, who had read Lyell, and played a role in mapping coal in Natal.[51] English-born Edward Dunn was part of the Cape Colony's geologic survey, and played some role in the discovery of diamonds, and produced the first geologic map of South Africa. Nevertheless, the relative absence of trained geologists or mining engineers in the early years of diamond mining in Kimberly during the 1870s is notable. This may account for why Gardner F. Williams, a graduate of the University of California and Freiberg's *Bergakademie*, came to manage and dramatically reorganize De Beers' diamond mines in the early 1880s. Williams' own account, *The Diamond Mines of South Africa* (1902) remains a standard reference on diamonds. Williams' rich work cites few authorities on the geology of diamonds, one exception being a Freiberg professor, A. W. Stelzner.[52]

Further, nine years after the start of industrialized gold mining on the Witwatersrand, two British mining engineers lamented that the South African Republic had yet to conduct a

[49] William Beinart and Saul Dubow, *The Scientific Imagination in South Africa: 1700 to the Present* (Cambridge: Cambridge University Press, 2021), 95. The point about a dearth of research is made by a recent exception: Suryakanthie Chetty, "David Draper: The Making of a South African Geologist," *Historia* 63, no. 2 (2018): 17–39.
[50] Beinart and Dubow, *Scientific Imagination*, 95–98.
[51] Chetty, "David Draper," 21, 29.
[52] Gardner F. Williams, *The Diamond Mines of South Africa: Some Account of Their Rise and Development* (New York: Macmillan, 1902), 476.

proper geologic survey of the Witwatersrand. The authors, Frederick Hatch and J.H. Chalmers, underlined to their readers in the metropole the seriousness of this failing on the part of the Afrikaner state that controlled the goldfields: "The importance of having the geological formations properly mapped […] cannot be exaggerated," and moreover, the cost "would be amply repaid by the benefit that the industry and the country generally would without doubt receive therefrom." [53] Hatch and Chalmers gave the book's foreword over to John Hays Hammond to discuss the "Future of the Rand," whose "position in the Mining World," Hatch wrote, "is too well known to need any comment on my part."[54] The next year, 1896, George F. Becker, a geologist with the United States Geological Service, came to the Rand to do what became one of the most cited geologic surveys of the Rand.[55] It is no coincidence that both Hammond and Becker were graduates of *both* leading US scientific schools and German mining schools (Hammond, Yale's Sheffield Scientific School and the *Bergakademie* at Freiberg, and Becker, Harvard and a doctorate from the University of Heidelberg.) To understand the US part of this and why it was US engineers and geologists leading geologic understanding of the particular "banket" formation of the Rand, we need to look at the practice of geology in the nineteenth century United States.

[53] Frederick H. Hatch and J. A. Chalmers, *The Gold Mines of the Rand* (London: Macmillan, 1895), 10–11.
[54] Hatch and Chalmers, *Gold Mines*, *vi*.
[55] Although published in other outlets like London's *Economist* magazine with mining investors in mind*,* the key publication was George F. Becker, "Witwatersrand Banket, with Notes on Other Gold-Bearing Pudding Stones," in *Eighteenth Annual Report of the United States Geological Survey, Part V*, 1897, 153–84. For a terrific account of Becker's role in South Africa and the Philippines on behalf of empire, see Hendrickson, "Advance Agent of Expanding Empires." For Becker in the context of the Department of the Interior's role in US empire, see Megan Black, *The Global Interior: Mineral Frontiers and American Power* (Cambridge, MA: Harvard University Press, 2018), 39–47.

There, as Paul Lucier has shown, geology was the one branch of science in early nineteenth century US that observers considered as measuring up to European science, receiving a considerable amount of patronage from its tight connections to industry.[56] In the first years after the gold rush, however, it was geologists Clarence King and James D. Hague who published a 600-page volume on the economic geology of the US West, demonstrating that there was long-term value beyond a quick boom-and-bust, as most contemporary observers believed.[57] King had studied under leading geologists James D. Dana—author of the leading *Dana's Manual of Mineralogy*—and George Brush at Yale's Sheffield Scientific School. Hague began his geological training at Harvard's Lawrence Scientific School before further study at the *Bergakademie* in Freiberg. Crucially, unlike in Saxony, or the copper smelting of Wales, in the US West, geological and metallurgical techniques were chiefly in the service of profit, or at least to provide previous metals for states to coin.

When it comes to the subject of geology, the historiography of the US West is dominated by the career of John Wesley Powell.[58] Powell is best known for exploring the Grand Canyon, and for his work on water, but should be better known for his work in ethnology. He was the first director of the Smithsonian's Bureau of Ethnology, and Powell's study of the Utes was a major factor in reservation policies designed to open up land for settlers. A historiographical emphasis on water and irrigation in the US West has led to a focus on Powell's

[56] Lucier, *Scientists and Swindlers*, 318–23.
[57] Curtis, *Gambling on Ore*, 86–88. James D. Hague and Clarence King, *Mining Industry* (Washington, D.C: Government Printing Office, 1870).
[58] Wallace Stegner, *Beyond the Hundredth Meridian: John Wesley Powell and the Second Opening of the West* (Boston: Houghton Mifflin, 1954); Donald Worster, *A River Running West: The Life of John Wesley Powell* (Oxford: Oxford University Press, 2001). For Powell as social Darwinist, see Lee D. Baker, *From Savage to Negro: Anthropology and the Construction of Race, 1896-1954* (Berkeley: University of California Press, 1998), 38–42; Black, *Global Interior*, 28.

irrigation work, obscuring the work of other geologists.[59] Under Powell's tenure as the second director of the US Geological Survey (1881-1894), Powell steered the Survey away from mining.[60] This focus on ethnography and water is an early example of how white extractivists were involved in far more than simply mineral extraction, but were intensely interested in profit as well.

The relation of geology and profit is also clear in the career of one Canadian-born mining engineer, David Brunton, who did graduate work at the University of Michigan before moving to the US West. Brunton commonly testified as an expert witness in lawsuits over what are known as "apex claims."[61] As a result of the geologic work to clarify property rights, Brunton developed novel methods of visualizing ore deposits. That this geologic knowledge could be used for profit was only natural to Brunton, but he complained that the managers and superintended were too slow to understand the utility of this method.[62] More broadly, in the US West, fossilized dinosaur specimens and mineral extraction were tightly imbricated, materially and culturally, illustrating once again the connections between geology, paleontology, and mining.[63] Ideas about humans and ideas about the earth were inseparable in the minds of mining engineers.

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[59] For examples, see Donald Worster, "Hydraulic Society in California: An Ecological Interpretation," *Agricultural History* 56, no. 3 (July 1982): 503–15; Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (Oxford: Oxford University Press, 1992); Marc Reisner, *Cadillac Desert: The American West and its Disappearing Water* (New York: Penguin, 2017 [1986]).
[60] Lucier, "A Plea for Applied Geology," 292.
[61] For more on how mining engineers served this legal function see, Spence, *Mining Engineers and the American West*, 195–230; Sarah E. M. Grossman, "Mining Engineers and Fraud in the U.S.–Mexico Borderlands, 1860–1910," *Technology and Culture* 55, no. 4 (October 2014): 821–49.
[62] Rickard, *Interviews*, 79–82. For more on Brunton, see Nystrom, *Seeing Underground*, 88–109.
[63] Lukas Rieppel, *Assembling the Dinosaur: Fossil Hunters, Tycoons, and the Making of a Spectacle* (Cambridge, MA: Harvard University Press, 2019), 14–42.

Mining and White Extractivism

If geology was a key scientific input into white extractivism's theory, its praxis was equally significant. Recent reconsiderations have emphasized that extraction, capitalism, colonialism, and mining ecologies have long been entangled.[64] One historian has shown convincingly that mining in medieval and early modern Europe was decidedly capitalist in nature.[65] At least since 1545 and the silver rush at Potosí in the highlands of present-day Bolivia, which "prompted land invasions, brutal work regimes, disease epidemics, ethnocide, political corruption, and rapid destruction of the natural environment," extraction has always been about extracting ore and knowledge, and controlling humans and nonhumans, as Allison Bigelow has shown for early modern Spanish empire.[66] In short, empire and extraction have long walked hand-in-hand.

In the US context this is no less true, and the most pivotal moments are the California Gold Rush and the Comstock. California in 1848 was the setting for a tale familiar to most U.S grade-schoolers: James W. Marshall discovered gold at Sutter's Mill in Coloma, a now largely abandoned town near Sacramento, and was soon followed by 300,000 other fortune seekers.[67]

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[64] "Mining ecologies" is borrowed from Daviken Studnicki-Gizbert, who defines it as "the matrix of intersecting components—socioeconomic relations, physical and biotic systems, as well as energy and material flows—that constituted the landscape wrought by mining." Studnicki-Gizbert, "Exhausting the Sierra Madre: Mining Ecologies in Mexico over the *Longue Durée*," in *Mining North America: An Environmental History since 1522* ed. J.R. McNeill and George Vrtis (Oakland: University of California Press, 2017), 21–22.

[65] Jeannette Graulau, "Capitalist Miners in Feudal Europe: A Commentary on Marxist Agrarian History," *Journal of Agrarian Change* 19, no. 4 (October 2019): 596–613.

[66] Kris Lane, *Potosí: The Silver City That Changed the World* (Oakland: University of California Press, 2019), xiii; 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).

[67] Rodman Paul; Susan Lee Johnson, *Roaring Camp: The Social World of the California Gold Rush* (New York: W. W. Norton, 2000); Malcolm Rohrbough, *Days of Gold: The California Gold Rush and the American Nation* (Berkeley: University of California Press, 1997); Elliott West, *The Contested Plains: Indians, Goldseekers, and the Rush to Colorado* (Lawrence: University Press of Kansas, 1998). For one analysis of how this migration transformed at least

So many so-called "Argonauts" converged on many abandoning their ships in San Francisco's quickly congested harbor. Historians are beginning to appreciate that 1848 represents just the first of a series of gold rushes that, as two leading practitioners put it, "set the world in motion" like nothing else had over the subsequent half century.[68] Broadly, this vein of writing dispenses with and moves beyond the deeply held mythology of the "49ers"— laden with settler nostalgia for grizzled prospectors striking it rich, and epitomized by the figure of Sourdough Sam, the mascot of the San Francisco's professional football team, the 49ers.[69] Although this mythology has been challenged by much of the New Western History written in the 1990s and 2000s, California became the laboratory on a global scale for working out how to efficiently and profitably extract and refine ore.[70] The real setting, then, is important: having just annexed the territory from Spain in 1846, as part of the Mexican-American War and creating a new racial category of "Mexican" that was pivotal to the larger restructuring of the US racial order, US military officials intensified Mexican policies towards Indians and California settlers then embarked upon the best-documented case of settler colonial genocide in US history.[71] In ways that foreshadow the labor migrations of southern and central Africa in the late nineteenth and twentieth centuries, people from Australia, Peru, China, Mexico, Canada, the US Midwest—

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one distant locale, Panama, see Aims McGuinness, *Path of Empire: Panama and the California Gold Rush* (Ithaca, NY: Cornell University Press, 2008).

[68] Benjamin Mountford and Stephen Tuffnell, "Seeking a Global History of Gold," in *A Global History of Gold Rushes* (Oakland: University of California Press, 2018), 3.

[69] Bruce Barcott, "The Real Story of the 49ers," *The Atlantic*, February 2, 2020, https://www.theatlantic.com/ideas/archive/2020/02/real-story-49ers/605911/.

[70] Key examples include Patricia Nelson Limerick, *The Legacy of Conquest: The Unbroken Past of the American West* (New York: W. W. Norton, 1987); Richard White, *"It's Your Misfortune and None of My Own": A New History of the American West* (Norman: University of Oklahoma Press, 1991).

[71] Laura E. Gomez, *Manifest Destinies: The Making of the Mexican American Race* (New York: NYU Press, 2008), 5; Benjamin Madley, *An American Genocide: The United States and the California Indian Catastrophe, 1846-1873* (New Haven, CT: Yale University Press, 2016), 1.

many of whom were indigenous—came to the goldfields in addition to Anglo settlers.[72] The final major departure from the mythologized version is that the image of prospectors panning in rivers for alluvial gold, a process known as placer mining. Placer mining, in turn, ceased to be a profitable venture for most prospectors within the span of just a few years. Already by 1853 prospecting was beginning to be replaced by the far more destructive practice of hydraulic mining. In short, as Manu Karuka writes of Nevada in this period, California and Nevada constituted an "extractive social order."[73] Elliott West has argued that along with "Bleeding Kansas," California at midcentury should be seen as "Bloodier California," as part of an extended process of "Greater Reconstruction."[74]

After the California gold rush, the next "rush" to extract minerals was in western Utah Territory (now Nevada). As the Western Shoshone scholar Ned Blackhawk has shown, successive waves of violence swept over this area as empires wrought many kinds of pain on Utes, including an "onslaught of American expansion that accelerated in the aftermath of the U.S.-Mexican War."[75]

Far less known but perhaps as important to the sweep of US history as California's gold rush to the development of a mineral extraction industry in the US was the discovery of the Comstock silver lode in what was then Utah Territory (now Nevada).[76] Most of the men in

[72] Andrew Shaler, "Indigenous Peoples and the California Gold Rush: Labour, Violence and Contention in the Formation of a Settler Colonial State," *Postcolonial Studies* 23, no. 1 (March 2020): 79–98.
[73] Karuka, *Empire's Tracks*, 6.
[74] Elliott West, "Reconstructing Race," *Western Historical Quarterly* 34 (Spring 2003): 7–26.
[75] Ned Blackhawk, *Violence over the Land: Indians and Empires in the Early American West* (Cambridge, MA: Harvard University Press, 2006), 177.
[76] On the Comstock Lode, see Hubert Howe Bancroft, *History of Nevada, Colorado, and Wyoming, 1540-1888*, vol. 25, The Works of Hubert Howe Bancroft (San Francisco, 1890), 92–149; George D. Lyman, *The Saga of the Comstock Lode: Boom Days in Virginia City* (New York: Scribner, 1934); Rodman W. Paul and Elliott West, *Mining Frontiers of the Far West, 1848-1880*, Revised ed. (Albuquerque: University of New Mexico Press, 2001 [1963]);

charge of extraction at Comstock were not trained in geology or engineering, but rather had wide business experience. Geologists complained that Comstock had been extracted wastefully and inefficiently. Indeed, the focus of the "old Comstockers," writes mining historian Clark Spence, "was on handling men, rather than techniques."[77] Even as "old Comstockers" became a residual, rather than dominant, cultural role in the 1870s, men like Hamilton Smith Jr., Thomas Mein, and Henry Perkins were important mentors to the emergent professional class of mining engineers in the 1870s and continued to exercise considerable influence in the profession and industry until at least the turn of the century.

The establishment of numerous mining engineering schools in the years after the Civil War meant that the rough culture of the Comstock was the environment into which young engineers first learned practical job skills. How they fared is the subject of chapter 2, but it is worth considering briefly here how they bridged geology and the "handling of men." The establishment of mining and engineering schools like Columbia Mines led one expert to write in 1871 that it was "one of the best schools in the world—more scientific than Freiberg, more practical than Paris."[78] James Dwight Dana's *Manual of Geology*, first published in 1863, was an important textbook for US mining engineers until at least 1900.[79] However, as Walter Vicenti has shown, engineering is not simply derivative of science.[80] One difference for engineering was that unlike early nineteenth century geology, which in general was equally at home dealing

Richard E. Lingenfelter, *Bonanzas & Borrascas: Gold Lust and Silver Sharks, 1848-1884* (Norman: University of Oklahoma Press, 2012), 85–153.

[77] Spence, *Mining Engineers and the American West*, 19.

[78] John A. Church, as quoted in Spence, *Mining Engineers and the American West,* 38.

[79] Spence, *Mining Engineers and the American West,* 39.

[80] Walter G. Vincenti, *What Engineers Know and How They Know It: Analytical Studies from Aeronautical History* (Baltimore: Johns Hopkins University Press, 1990).

with coal and hard rock metals, was that in the US, there was a distinct cleavage. While geology had an influence on coal mining, however, coal mining remained largely separate from hard rock mining in that it preferred to promote from within rather than hire professional engineers.[81] In part, this may have had to do with the fact that coal deposits are stratigraphic, while hard rock minerals are typically in vein deposits, and each required a different set of skills to extract. While it is difficult to mark precisely when geology and engineering coincided, as there is a series of gradual shifts, Eric Nystrom has shown that for most US mining engineers, it began in the 1880s as mining engineer education programs grew tremendously, and the two modes of thinking continued to be conflated into the twentieth century, as Jeffrey Manuel has shown for iron mining.[82] Mining engineers at work on hard rock mines were uniquely positioned even relative to coal mining in their increasing professionalization and role as managers of labor.

Agassiz at Harvard's Lawrence Scientific School

These social, political, intellectual, and scientific currents came together at many places, not only in the United States. Harvard University's Lawrence Scientific School (Image 1), founded in 1847, was thus only exceptional in how clearly and forcefully these trends converged. Named for its benefactor, Boston capitalist Abbott Lawrence, it was begun with the intention of training better engineers for Lawrence's textile mills in Lowell, Massachusetts.[83] Lawrence

[81] Thomas G. Andrews, *Killing for Coal: America's Deadliest Labor War* (Cambridge, MA: Harvard University Press, 2008), 167. For an overview of coal's place in global history, see Barbara Freese, *Coal: A Human History* (New York: Basic Books, 2003).
[82] Nystrom, *Seeing Underground*, 52; Jeffrey T. Manuel, "Efficiency, Economics, Environmentalism: Low-Grade Iron Ore Mining in the Lake Superior District, 1913-2010," in *Mining North America: An Environmental History since 1522*, ed. J.R. McNeill and George Vrtis (Oakland: University of California Press, 2017), 191–216.
[83] Louis Menand, *The Metaphysical Club: A Story of Ideas in America* (New York: Farrar, Straus and Giroux, 2001), 99.

thought of himself as a self-made man, an image skewered by his fictional appearance in Herman Melville's 1857 novel *The Confidence-Man: His Masquerade*.[84] Lawrence lamented that, despite a well-educated population, there was nowhere to "send those who devote themselves to the practical applications of science." The problem facing a growing country, as Lawrence saw it, was that "Our country abounds in men of action. Hard hands area ready to work upon our hard materials; and where shall sagacious heads be taught to direct those hands?" Lawrence proposed "three great practical branches" for the application of a scientific education: engineering; mining and metallurgy; and machinery. Lawrence offered $50,000 and instructed that "there should be the most thorough instruction in Engineering, Geology, Chemistry, Mineralogy, Natural Philosophy, and Natural History."[85] Lawrence's plans for a school at which natural history, geology, and engineering worked together in the pursuit of profit and continental imperialism mark one key input of white extractivism.

Those plans were immediately set aside with the arrival of Louis Agassiz in Boston. Born in Switzerland, Agassiz's two most significant intellectual mentors were Humboldt and Georges Cuvier.[86] Agassiz had for some time dreamed of traveling to the United States, and his dreams were propelled by both Humboldt, who convinced the king of Prussia to grant Agassiz the funds

[84] Herman Melville, *The Confidence-Man: His Masquerade* (London, 1857); William Norris, "Abbott Lawrence in the Confidence-Man: American Success or American Failure?," *American Studies* 17, no. 1 (Spring 1976): 25–38; Helen P. Trimpi, *Melville's Confidence Men and American Politics in the 1850s*, (Hamden, CT: Shoe String, for The Connecticut Academy of Arts and Sciences, 1987), 103–5. On reading US history through Melville's fiction, see C. L. R. James, *Mariners, Renegades and Castaways: The Story of Herman Melville and the World We Live In* (New York: C. L. R James, 1953).

[85] Abbott Lawrence to Samuel A. Eliot, June 7, 1847, in Hamilton Andrews Hill, *Memoir of Abbott Lawrence*, Second Edition (Boston: Little, Brown, 1884), 117–22.

[86] Agassiz has only been the subject of two biographies in the last half century: Edward Lurie, *Louis Agassiz: A Life in Science* (Chicago: University of Chicago Press, 1960); and Christoph Irmscher, *Louis Agassiz: Creator of American Science* (Boston: Houghton Mifflin Harcourt, 2013). On Agassiz's role in developing the Brazilian Amazon, see Roberto Saba, *American Mirror: The United States and Brazil in the Age of Emancipation* (Princeton, NJ: Princeton University Press, 2021), 94–104. On Cuvier, see da Silva, *Global Idea of Race*, 97–107.

for two years of geological study, and Lyell, who secured an appointment for a series of public lectures in Boston in 1846–47.[87] While the lectures were intended only to secure funds for research, they were attended by thousands and brought Agassiz to wide renown, including to Lawrence. Agassiz lectured on fish and his theories of a glacial period—the concept of an "Ice Age" is credited to him—but more popular were his Lowell lectures on natural history, where white Boston audiences heard that their "species" were "not only the highest form of vertebrates but represented the direction and purpose to which all creation had moved from the beginning."[88] As his biographer Irmscher writes, "Agassiz took to America like a fish to water."[89]

Agassiz's celebrity and spectacle were sufficiently dazzling to get Lawrence to abandon his plans for an applied science professor, and less than a year after arriving in the US, in September 1847 Agassiz was offered a professorship funded by Lawrence.[90] Accepting Harvard's offer also meant Agassiz's visit to the US was permanent, and also meant abandoning his unwell wife Cecilie in Europe. Even before Agassiz began his lectures, he toured the northeast to connect with the US scientific community, and a visit to Samuel George Morton in Philadelphia was among the first. [91] The author of *Crania Americana*, Morton was the most renowned anthropologist in the US, famed for his empirical studies of skull sizes (craniology) as they related to race, and the visit signaled Agassiz's abiding interest in racial ethnology.[92]

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[87] Irmscher, *Louis Agassiz*, 80.
[88] Lurie, *Louis Agassiz,* 126–27.
[89] Irmscher, *Louis Agassiz*, 2.
[90] Irmscher, *Louis Agassiz*, 94–95.
[91] Menand, *Metaphysical Club*, 102.
[92] Melissa J. Stein, *Measuring Manhood: Race and the Science of Masculinity, 1830–1934* (Minneapolis: University of Minnesota Press, 2015), 35–43. On Agassiz and race, also see Stephen Jay Gould, *The Mismeasure of Man*,

Agassiz is best known, or more accurately, most infamous, for his daguerreotypes of enslaved people, commissioned in 1850 to pursue evidence for his belief in black inferiority.[93] These images are in fact representative of a much wider influence Agassiz held in elite social and scientific circles and especially but not least among proslavery ideologues. While less known today than other members such as Henry Wadsworth Longfellow, James Russell Lowell, and Oliver Wendell Holmes, the monthly dining and conversation society, the Saturday Club, was in fact widely referred to instead as "Agassiz's Club."[94] Similarly, Harvard's museum of Comparative Zoology, funded in part by Agassiz's appeal to the Massachusetts legislature, was commonly known as the "Agassiz museum."[95] In this way, Agassiz's Humboldtian ideas about natural history and how it should be displayed were shared to a wider public. Despite his insistence that science was separate from politics, Agassiz "provided scientific ammunition to the politicians of his own time and well beyond it."[96] One of the most significant outcomes of Agassiz's 1850 visit to South Carolina was the beginning of his association with Josiah Nott and George Gliddon, scientific racists committed to polygenesis. Nott, a slaveholder in Alabama, and Gliddon went out of their way to court Agassiz, getting him to agree to write the foreword to their book, *Types of Mankind*, which attempted to demonstrate the superiority of the white race.[97] Historian Lee Baker has argued that *Types of Mankind* was "perhaps the most important

Revised and Expanded (New York: W. W. Norton, 1996), 74–82; Marion K. McInnes, "Looking for Louis Agassiz: A Story of Rocks and Race in Maine," *Mosaic: An Interdisciplinary Critical Journal* 52, no. 2 (June 2019): 35–56.

[93] Brian Wallis, "Black Bodies, White Science: Louis Agassiz's Slave Daguerreotypes," *American Art* 9, no. 2 (July 1995): 39–61; Karsten Moran, "Who Should Own Photos of Slaves? The Descendants, not Harvard, a Lawsuit Says," *New York Times*, March 20, 2019.

[94] Menand, *Metaphysical Club*, 99.

[95] Irmscher, *Louis Agassiz*, 119.

[96] Menand, *Metaphysical Club*, 101.

[97] Menand, *Metaphysical Club*, 111–12; Irmscher, *Louis Agassiz*, 239–45.

book on race during the contentious antebellum period," and was republished ten times in the next few decades.[98]

In ways that prefigured the technocratic, expert consulting role that mining engineers would later play in wartime, Agassiz was chosen as expert adviser to Samuel Gridley Howe's American Freedmen's Inquiry Commission. Committed to antislavery despite his racism and given his public stature, Agassiz was ideally suited for the role. In short, his suggestions: racial segregation and the avoidance of "miscegenation," were shibboleths of white, and especially southern white, reaction to emancipation for decades to come.[99] In the years after the Civil War, however, despite Agassiz's contributions to the scientific study of ice and fish, his stubborn insistence on polygenesis made him increasingly out of step with the wider European scientific community's shift to monogenism, hailed by with the publication of Darwin's *On the Origin of Species*. To speak of Agassiz's legacy, then, is less about "science" than it is about its social and political consequences.

Indeed, Frederick Douglass accurately described Agassiz, along with Morton, Nott, and Glidden, as merely "Southern pretenders to science."[100] In the decades after emancipation, as Khalil Gibran Muhammad has shown, theories of race migrated from the natural to the social sciences.[101] Regardless, returning to geology, one of the signal but underappreciated outcomes of the geohistory approach that Agassiz and others pursued in the 1840s was the progressive

[98] Baker argues that those three represent the three most influential figures in the American school of anthropology. Baker, *Savage to Negro*, 15–16.
[99] Irmscher, *Louis Agassiz*, 244–65.
[100] Quoted in Britt Rusert, *Fugitive Science: Empiricism and Freedom in Early African American Culture* (New York: NYU Press, 2017), 126–27.
[101] Khalil Gibran Muhammad, *The Condemnation of Blackness: Race, Crime, and the Making of Modern Urban America* (Cambridge, MA: Harvard University Press, 2010).

nature of life and, by extension, history.[102] This concept of temporality and teleology, made possible by new advances in geology, has been underexamined by historians, but it is worth pointing to because of the way it would be taken up by one of Agassiz's students, Nathaniel Southgate Shaler.

Josiah Whitney and The Failure of Pure Geology at Harvard

Before Shaler arrived at Harvard, while the Lawrence Scientific School moved in the direction of research rather than applied science, rival universities began their own mining schools, most notably Columbia University's School of Mines in 1864 and the Massachusetts Institute of Technology (MIT), which offered a course in geology and mining upon the school's opening in 1865. Universities filled the void created when government surveys no longer functioned as training grounds. In this context, Louis Agassiz, in his role as dean of the Lawrence Scientific School, decided to create a School of Mining, which opened in 1865. Agassiz recruited Josiah Dwight Whitney, a geologist who had headed the California Geologic Survey since 1860. In recognition of these efforts, members of the survey named the highest mountain in California's Sierra Nevada "Mount Whitney."[103] Like Agassiz, Whitney was a "devoted Humboldtian," having made the "requisite pilgrimage" to visit Humboldt in Berlin in 1844. While Whitney did not embrace Humboldt's emphasis on subjectivity, as Aaron Sachs has shown, he did insist on a "pure" geology, separate from commerce.[104] Whitney's distaste for profit's role in science made him an uneasy fit for a teaching position at the School of Mining,

[102] Martin J. S. Rudwick, *Worlds Before Adam: The Reconstruction of Geohistory in the Age of Reform* (Chicago: University of Chicago Press, 2008), 146–48.
[103] Edwin Tenney Brewster, *Life and Letters of Josiah Dwight Whitney* (Boston: Houghton Mifflin, 1909), 238.
[104] Sachs, *Humboldt Current*, 203.

also causing him to be unpopular with students in search of careers. Whitney's insistence on pure science was a significant reason the mining school only lasted until 1875, when it was merged with the Lawrence Scientific School and Whitney given his old position of Sturgis-Hooper Professorship of Geology.[105] Paul Lucier is correct to note that the failure demonstrates the imbrications of science and commerce in this period, but a closer examination of Whitney's defense of geology demonstrates a key difference between geology and White Geology. Writing against critics of geology and in defense of expanded "pure" geologic research, Whitney—who was no stranger to mining—allowed that extraction was fundamental to geology as it was practiced in the US, writing that "It is chiefly through its intimate connection with the art of mining and the development of the mineral resources of the country, that geology has acquired the importance which it now has, and especially in its relation to the state." Whitney also attempted to rebut critics who reproached geologists "that their science is one in which hypotheses and theories predominate over facts"—that geologists' "fancies are many and its figures few." Nevertheless, Whitney placed geology alongside astronomy as the two most powerful influences "on the intellectual development of mankind," implicitly putting Werner, Lyell, Murchison on the same shelf as Copernicus, Kepler, and Galileo. Yet the *reason* geology rather than its applied counterpart had no purchase in the post-Civil War empire of industry can be identified in Whitney's own admission: that geology "does not furnish numerical results."[106] Numerical reasoning and the sheen of objectivity that they provided were, as we have seen, essential to the "racial calculus" of White Geology.

[105] Brewster, *Life and Letters of Josiah Dwight Whitney*, 318.
[106] J. D. Whitney, *Geographical and Geological Surveys* (Cambridge, MA: Welch, Bigelow, 1875), 53–56.

Nathaniel Southgate Shaler

Following Whitney's failure to build up the student body and reputation of the Mining School, the School turned to Nathaniel Southgate Shaler, "a man of extraordinary gifts for interesting and inspiring boys."[107] Shaler was born in 1841 in Newport, Kentucky, on the other side of the Ohio River from Cincinnati, Ohio. Shaler was an undergraduate at Harvard, originally a classics student, but after one course with Agassiz he transferred to the Lawrence Scientific School.[108] As Shaler recalled after the first encounter with Agassiz, "I was at once his captive."[109] The feeling was apparently mutual, because when word reached Cambridge that the Confederacy had fired on Fort Sumter in April 1861, it was to Shaler that Agassiz turned.[110] Referring to abolitionists, Agassiz exclaimed through tears, "They will Mexicanize the country!"[111] After working under Agassiz, and serving in the Union Army during the war, in 1866 Shaler left for Europe with a letter of introduction from Agassiz, who described Shaler as "the one of my students whom I love the best."[112] Shaler was almost certainly directed toward the *École des Mines* in Paris and the *Bergakademie* at Freiberg by Agassiz, where at the latter he took instruction in the practical methods of mining for a brief time in 1868 as part of his tour through Europe. At Freiberg, Shaler met the geologist Carl Bernhard von Cotta, a leader on the

[107] Brewster*, Life and Letters of Whitney* (Boston: Houghton Mifflin, 1909), 320.
[108] David L. Browman and Stephen Williams, *Anthropology at Harvard: A Biographical History, 1790-1940* (Cambridge, MA: Peabody Museum Press, Harvard University, 2013), 72.
[109] Nathaniel Shaler, *The Autobiography of Nathaniel Southgate Shaler, with a Supplementary Memoir by His Wife* (Boston: Houghton Mifflin, 1909), 93.
[110] Quoted in Menand, *Metaphysical Club*, 101–102.
[111] For a background on fears of the "Mexicanization" US politics in this era—the term was used to describe a fear of the disintegration of democratic institutions, where every party conflict had the nature of a civil war—see G. P. Downs, "The Mexicanization of American Politics: The United States' Transnational Path from Civil War to Stabilization," *American Historical Review* 117, no. 2 (2012): 387–409.
[112] David N. Livingstone, *Nathaniel Southgate Shaler and the Culture of American Science* (Tuscaloosa: University of Alabama Press, 1987), 31.

geology of ore deposits, and also "took a hand at the manual labor of the workmen."[113] Shaler's wife, Sophia Penn Page Shaler, recalled that when Shaler recounted his time in Freiberg, he often recalled that "many of the miners had the ends of their fingers eaten off as a consequence of handling arsenic, and, in some instances, their noses were also reduced in size; otherwise they were a healthy-looking lot of men."[114] With the imprimatur of Agassiz and von Cotta, Shaler returned to Cambridge, Massachusetts that same year to take up an appointment as Professor of Paleontology and stayed for life. After his professorship was changed to Geology in 1888, he became Dean of the Lawrence Scientific School in 1891, retaining the position until his death in 1906. While Shaler continued to pursue fieldwork in places like Nova Scotia, Ontario, and Florida, as well as directing the Kentucky Geological Survey from 1873 to 1880, he lived at a far remove from underground workers. Nevertheless, Shaler was never quite at home in Boston society: he felt his Kentucky origins rendered him an outsider, and he had a "persistent sensitivity to Brahmin exclusiveness."[115] Shaler's own self-regard stemmed from how his knowledge was applied: "He used laughingly to say that whatever he might be in Cambridge he was a great man in the Rockies."[116]

It is therefore not surprising that Shaler's significance lies not in any particular scientific advancement, of which he is not well known, but in his capacity for synthesis. Shaler mostly expressed those syntheses through popular writing and teaching. At the most general level, Shaler combined neo-Lamarckism—the idea that organisms transmit characteristics acquired

[113] For more on von Cotta, see Bernhard von Cotta, *A Treatise on Ore Deposits*, trans. Frederick Jr. Prime (New York: D. van Nostrand, 1870); R. Noel, "Bernhard Von Cotta," *Nature* 20 (September 25, 1879): 505–6.
[114] Shaler, *Autobiography*, 243–44.
[115] David N. Livingstone, "Science and Society: Nathaniel S. Shaler and Racial Ideology," *Transactions of the Institute of British Geographers* 9, no. 2 (1984), 188.
[116] Shaler, *Autobiography*, 337; Baker, *From Savage to Negro*, 15–16, 45–48; Menand, *Metaphysical Club*, 97–112.

during their lifetime to their offspring—with popular racist attitudes. Shaler's method—what might variously be described as anthropology, geography, or anthropogeography—allowed him to believe he could define "man in both biological and cultural evolutionary terms."[117] This synthesis of biology and culture was evident in arguably his best known, or at least most widely read article, published in the *Atlantic Monthly* in 1884. There, Shaler responded to the "Negro Question" confronting the New South.[118] Shaler summed up his deeply dark views on the co-existence of both whites and blacks in the United States "in brief words—uniform, hopeless failure, a sinking toward the moral conditions of the Congo and the Guinea coast." While he blamed "our dull, greedy ancestors of the seventeenth and eighteenth centuries" for the "Negro problem," the solution Shaler proposed was continued "training in civilization" for diasporic Africans in the United States—continued because, he believed, it had "begun in slavery." Accordingly for Shaler, "The proper beginning is to give him ['the negro'] a chance to receive the benefits of the education that comes from varied and skillful industry."[119] Accordingly, he emphasized the interplay of race and geography, an argument he devoted the second half of his popular 1891 book *Nature and Man in America* to demonstrating.[120] Like his mentor Agassiz, who claimed on a visit to a South Carolina plantation in 1850 that he could tell which region of Africa enslaved people were from, "even when they attempted to deceive him," Shaler emphasized that African-descended people in the United States were not

[117] Livingstone, "Science and Society," 185.
[118] On the New South and the "Negro Question," see especially C. Vann Woodward, *Origins of the New South, 1877-1913* (Baton Rouge: Louisiana State University Press, 1951); Edward L. Ayers, *The Promise of the New South: Life After Reconstruction* (New York: Oxford University Press, 1992); Barbara J. Fields, "'Origins of the New South' and the Negro Question," *Journal of Southern History* 67, no. 4 (November 2001): 811–26.
[119] Nathaniel Shaler, "The Negro Problem," *Atlantic Monthly*, November 1884.
[120] N. S. Shaler, *Nature and Man in America* (New York: Scribner's, 1891).

homogenous in terms of their geographical origin, biology, or intellect.[121] Shaler argued that blacks were superior to both most whites and especially indigenous North Americans in one significant way: their capacity for labor. It was on this basis that Shaler argued for a contingent of African Americans to help the US colonize the Philippines in 1900, a proposition soon taken up with enthusiasm by a Jim Crow defending Alabama senator, John Tyler Morgan, and in turn, Secretary of War Elihu Root.[122] Shaler's plan, nevertheless, failed to gain enough traction to implement. Shaler's ideas about the superior capacity of African-descended people to labor were out of step with the prevailing ethos, dominated by people like the political scientist Paul Reinsch, and by statistician Frederick Hoffman, an actuary at Prudential Life insurance. Hoffman's view, based on the 1890 census, that African American efficiency had declined since emancipation.[123]

Shaler is not well known today and deserves anything but glorification. His ideas were influential yet outside the mainstream. Nevertheless, it is remarkable how little scholarly attention he has received, given that he was one of the leading figures of late nineteenth-century scientific racism and educated over seven thousand Harvard undergraduates, including future President Theodore Roosevelt.[124] Shaler and Roosevelt continued to correspond during Roosevelt's presidency, sharing notes about "valor" and Kentucky politics, among other

[121] Menand, *Metaphysical Club*, 111.
[122] For a discussion of Shaler's 1900 plans for the "Negro colonization" of the Philippines with African Americans, see Warwick Anderson, *Colonial Pathologies: American Tropical Medicine, Race, and Hygiene in the Philippines* (Durham, NC: Duke University Press, 2006), 101–102. For more on the connection between Shaler, Morgan, and Root, see Daniel E. Bender, *American Abyss: Savagery and Civilization in the Age of Industry* (Ithaca, NY: Cornell University Press, 2013), 88.
[123] Bender, *American Abyss*, 85. For more on Hoffman, see Megan J. Wolff, "The Myth of the Actuary: Life Insurance and *Frederick L. Hoffman's Race Traits and Tendencies of the American Negro,*" *Public Health Reports* 121 (January-February 2006): 84–91; Paul R. D. Lawrie, *Forging a Laboring Race: The African American Worker in the Progressive Imagination* (New York: NYU Press, 2016), 13–38.
[124] Baker, *Savage to Negro*, 48.

things.[125] Shaler even wrote for young children, explaining the deep history of the Klondike gold rush.[126] His passing in 1906 was widely mourned: “on the afternoon of his funeral, flags on city buildings and student fraternities were hung at half-mast, and shops in "old Cambridge" were closed. Such tributes had not been paid to another teacher in the university within the preceding generation.”[127] What his devoted students took away from their mentor is worth pursuing, as it formed a basis for white extractivism.

Agassiz, Jennings and Harvard’s Mining Engineers

Shaler took much of his Freiberg experience and training back to Massachusetts. Of his instructors at Freiberg, the economic geologist and associate of Agassiz, Raphael Pumpelly recalled that they were “as good comrades as any of us.” Students not only joined instructors on “frequent excursions” to places like Bohemia and Thuringia but joined them at restaurants, “drinking beer, smoking, and telling stories.” Pumpelly described Shaler as “the only American instructor I can recall who was a representative of the type of these men.”[128] Given that Shaler’s own mentor, Louis Agassiz, trained nearly every significant nineteenth century natural historian, their networks are very much intertwined. For instance, one of the Lawrence Scientific School’s most notable early graduates was Agassiz’s son Alexander Agassiz, who graduated in 1855. Alexander Agassiz became a mining engineer himself and following the Civil War, began to draw attention for his work at the Calumet and Hecla copper mines in Michigan.

[125] Letters from Nathaniel S. Shaler to Theodore Roosevelt, December 24 and December 31, 1902, Theodore Roosevelt Papers, Library of Congress Manuscript Division.
[126] Nathaniel S. Shaler, “Klondikes Old and New,” *The Youth’s Companion*, June 1, 1899.
[127] Livingstone, *Nathaniel Southgate Shaler*, 10.
[128] Pumpelly, *My Reminiscences*, 1:122–23.

There, the younger Agassiz got in touch with Pumpelly.[129] As one writer puts it, Calumet and Hecla and Agassiz were one and the same: "The fabulous story of Calumet & Hecla […] amounts to a biography of Alexander Agassiz." Although the mine developed to "world importance," it is questionable that Agassiz is really deserving of credit. More likely, fortuitous geology, personal connections, or both, can be credited.[130] At the Calumet and Hecla, Alexander Agassiz was fortunate to have been put in charge of the richest mine, and not one of the less productive ones nearby. Profits from extracting the copper were high enough to lead one writer to remark that Agassiz's management had piloted the Calumet & Hecla to "world importance."[131] As Larry Lankton writes in his history of Michigan copper mining, "Only the singularly rich C&H could afford Agassiz's technological style and fully satisfy his ample ego."[132] After a number of years, funds from the mine enabled Agassiz to return to what he felt were more pressing concerns: the Museum of Comparative Zoology founded by his father. Agassiz only visited twice a year, spending the rest of his time on expeditions collecting specimens or curating the museum.[133]

Even less known but legendary in the mining industry is a 1903 graduate of the Lawrence Scientific School, Thayer Lindsley. Born in Yokohama, Japan, Lindsley "spent most of his life scouring the globe for ore deposits," underlining white extractivism's intense globality.[134] Little is known of Lindsley, who was famously reclusive. The most information

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[129] David L. Browman and Stephen Williams, *Anthropology at Harvard: A Biographical History, 1790-1940* (Cambridge, MA: Peabody Museum Press, Harvard University, 2013), 141-143; Peggy Champlin, *Raphael Pumpelly: Gentleman Geologist of the Gilded Age* (Tuscaloosa: University of Alabama Press, 1994).
[130] Angus Murdoch, *Boom Copper: The Story of the First U. S. Mining Boom* (New York: Macmillan, 1943), 139–53.
[131] Murdoch, *Boom Copper*, 153.
[132] Larry Lankton, *Cradle to Grave: Life, Work, and Death at the Lake Superior Copper Mines* (New York: Oxford University Press, 1991), 44. For more on copper mining in the region, see T. A. Rickard, *A History of American Mining* (New York: McGraw-Hill, 1932), 222–48.
[133] Murdoch, *Boom Copper*, 149.
[134] "Thayer Lindsley, Geologist, Is Dead," *New York Times*, May 30, 1976.

comes from a 1951 article in Canadian newsmagazine *Maclean's*, which describes Lindsley as "a reclusive mystery man whose genius for evading the limelight is exceeded only by his genius for geology and mining finance." The reporter called the only Canadian classmate of Lindsley's at Harvard, who claimed to have never heard of him. Despite having being the "undisputed No. 1 figure in Canadian mining," and "having carved out Canada's biggest mineral empire" followed by "another international empire just as great," evidently no newspaper on earth had a photo of Lindsley or a file on his life.[135] J. David Lowell, a mining engineer who was at one time an employee of one of the many subsidiaries Lindsley owned, described Lindsley as a "legendary mine finder."[136] Indeed, as his entry in Canada's Mining Hall of Fame notes, Lindsley's "geological and creative genius touched the fortunes of perhaps more than 185 companies in all." Structured through a staggering number of subsidiary companies, Lindsley's "world-girdling empire of mining properties" touched Zimbabwe, Australia, France, Ontario, Utah, Mexico, among others. One of Lindsley's associates said of him, "He was a geological genius. He had an astonishing ability to look at a geological map in three dimensions and quickly circle the location of probable ore with a big red crayon."[137] Lindsley's mobility, along with his geological and financial savvy, mark him as a leading practitioner of white extractivism. What his Hall of Fame entry does not reveal, however, is the wake of toxicity left behind in some of the planet's most ecologically sensitive areas, including the notoriously polluted Giant Mine near

[135] Fred Bodsworth, "The Unknown Giant of Canadian Mining," *Maclean's*, August 15, 1951.
[136] J. David Lowell, *Intrepid Explorer: The Autobiography of the World's Best Mine Finder* (Tucson, AZ: Sentinel Peak, 2014), 118.
[137] "Thayer Lindsley," Canadian Mining Hall of Fame, accessed February 26, 2021, https://www.mininghalloffame.ca/thayer-lindsley.

Yellowknife, in Canada's Northwest Territories on the land of the Dene First Nation.[138] As I will show in Chapter 3, these genealogies and legacies of toxicity were and are a key element of white extractivism.

As with Lindsley, the public history of mining engineers is often uncritical and celebratory. While the younger Agassiz is memorialized in statue at the Keweenaw National Historic Park in Michigan, arguably one of Shaler's most significant students, another Kentuckian named Hennen Jennings, has been especially overlooked. Jennings was born in Hawesville, Kentucky in 1854, where his father owned a coal mine, although the family's roots were as Louisiana slaveholders. Educated in England for a number of years after the Civil War, Jennings graduated from Harvard's Lawrence Scientific School in 1877. Jennings credited much of his education to Shaler, who, he recalled, "having seen my name registered from Kentucky" and thinking Jennings "might be lonely," invited Jennings to his house. Thenceforth Jennings "had the privilege of considering him a true friend as well as teacher until his death." Jennings was later known as a mining engineer, but his education in fact had little to do with mining per se: at the time he was in Cambridge, "The mining course was not then well established," and instead he took the course in Civil Engineering. While he took Shaler's course in geology, Jennings emphasized that the course was "well attended by the academic students as well as the scientific," keeping with Shaler's desire to "bring the academic and scientific students in closer touch and to obtain for the future engineer a broader and more liberal education." As

[138] It is noteworthy that Lindsley's name is not discussed in either of these discussions of the Giant Mine and others: Liza Piper, "Subterranean Bodies: Mining the Large Lakes of North-West Canada, 1921–1960," *Environment and History* 13, no. 2 (May 2007): 156–86; John Sandlos and Arn Keeling, "The Giant Mine's Long Shadow: Arsenic Pollution and Native People in Yellowknife, Northwest Territories," in *Mining North America: An Environmental History since 1522*, ed. J.R. McNeill and George Vrtis (Oakland: University of California Press, 2017), 280–312.

Jennings admitted, the Lawrence Scientific School was "at a low ebb in point of members" while he was a student. While his civil engineering training was sufficient to give Jennings a "foundation in the general principles of engineering," few of the skills that would later bring him fame were acquired at the Lawrence Scientific School. Instead, perhaps following Shaler's example, threw himself into the intellectual ferment of Cambridge. His description of the range of thinkers he was connected with is worth quoting at length for its sheer variety and recognizable names:

> I was thrown not only into contact with my own classmates, but I made friends of students in other departments of the University and also with some of the distinguished men among the teachers. At that time there were concentrated at Cambridge and its vicinity a number of men of great distinction. Charles William Eliot was then a young and active president; Oliver Wendell Holmes and James Russell Lowell were lecturers; Henry Adams, John Fiske, and William James were connected with the University in the Academic Department in their several specialties. In the Scientific Department, Benjamin and James M. Pierce and Henry Lawrence Eustis were professors of mathematics; Asa Gray was professor of Natural History; Walcott Gibbs and John Trowbridge were Professor and Instructor, respectively, of Physics; Josiah Cook, Professor of Chemistry; and Josiah D. Whitney, Professor of Economic Geology. Longfellow was then living at Cambridge, and Emerson at Concord. Naturally I absorbed some of the atmosphere created by these men.[139]

The archive reveals scant traces of these influences on Jennings, perhaps because Jennings elected to emphasize his more industry-specific skills. It was significant enough, though, that thirty-two years after his graduation, Jennings was one of "several of the foremost authorities on engineering" in the United States who addressed the 1909 meeting of Harvard's Engineering Society. As the *Harvard Crimson* reported, Jennings "dwelt at length upon the untiring industry, the great versatility, and the great fund of information of the late Dean

[139] T. A. Rickard, *Interviews with Mining Engineers* (San Francisco: Mining and Scientific Press, 1922), 225.

Shaler, under whom the Lawrence Scientific School attained great importance."[140] Jennings acquired the other half of the traits central to white extractivism in the field: in California and Venezuela, especially. The consequences of the networks and knowledge assembled here are explored in subsequent chapters, but by the 1870s, a key component in the empire of industry was fully formed.

This chapter has traced the prehistory of white extractivism and in so doing sketched the intellectual patrimony and social capital that produced Hennen Jennings. While Jennings was hardly the only figure in the constellation of white settler engineers this dissertation studies, by the turn of the century, he was very much at its core. By situating and excavating the inheritance and genealogy of a leading practitioner we understand the character of white extractivism. How white extractivism was put to use remains to be examined. For that, we turn to the emergence of professional mining engineers like Jennings and Hammond in the United States, and their reliance on a fragile hypermasculinity to assert their place.

[140] "Good Speeches at Engineering Dinner," *Harvard Crimson*, March 22, 1909.

Image

Image 1: Lawrence Scientific School

Lawrence Scientific School, Photograph, 1867, n.d., n.d., Harvard University Archives HUV 170 (2-16), http://id.lib.harvard.edu/images/olvwork271238/catalog.

Chapter 2. Fantasies of Absolute Power: Engineers and White Settler Masculinity

> Of mining engineers, real and self-designated, there were many, but most of them were too far up in the clouds to have truck with ordinary hard-rock stiffs. They would have done better and learned more had they come down to earth.
>
> —Frank A. Crampton, *Deep Enough: A Working Stiff in the Western Mine Camps*

On a 1931 visit to Kirkland Lake, Ontario, a reporter for Canadian newsweekly magazine *Maclean's* was somewhat disappointed that the mining engineer in charge of the operation failed to live up to his profession's famed masculinity. Instead of the "North Country mine manager beloved of the popular fictionists," the journalist found the engineer, Maurice Summerhayes, looked "more like an English squire, or a fox-hunting man, than a mining engineer." Indeed, Summerhayes' whole deportment evidently did not fit the popular ideal, in dress, body, and speech: "In stature he is of middle height. His tweeds are well cut, and neat leggings encase his calves. He is impeccably tidy and speaks as softly as a woman." Despite failing to live up to gendered expectations, Summerhayes was nevertheless said to possess "mining brains," a quality demonstrated by turning around a deteriorating mine.[1] The English-born Summerhayes was a veteran of mines in California, Sonora, and Minas Gerais, and had been working at mines in northeastern Ontario for two decades. That qualified him as a solidly within the mining engineering fraternity, even if he never achieved anywhere near the fame or fortune as peers like Hammond or Hoover. This gap between myth and reality, however, is

[1] Leslie Roberts, "There's Gold in Them Thar Hills," *Maclean's*, March 1, 1931.

suggestive of how mining engineers more generally were always on the brink of failing to live up to their masculine, heteronormative reputation and presentation.[2]

Rather than embrace this failure in an emancipatory way, mining engineers persevered, continuing to believe in, assert, and wield the power of colonial masculinity.[3] In a word, they performed. This chapter will demonstrate how heteronormative cis-masculinity, alongside bourgeois whiteness, acted as the foundation for mining engineers attempts to manage, dominate, and possess the earth as well the humans and non-humans who lived upon it, the subject of the following three chapters. As Chapter 1 demonstrated, the application of science in the pursuit of profit, as well as the subjection of labor, are what separated mining engineers and white extractivism from geologists. Examining that in practice reveals tensions between myth and reality—as with the example of Summerhayes—and also between capital and labor, metropole and colony, rugged and refined. These were holes in a leaking ship that mining engineers attempted to patch with the glue of masculinity. By some contemporary measures, of course, mining engineers were spectacularly successful. A few became extraordinarily wealthy. Certainly, lots and lots of ore was extracted under their watch. Nevertheless, it was impossible to live up to a myth.

"Masculinity" is not understood here to be any singular or essential object but rather as a social and cultural demarcation that is constantly in flux. Masculinity, as R. W. Connell has

[2] Judith Butler, "Imitation and Gender Subordination," in *Inside/Out: Lesbian Theories, Gay Theories*, ed. Diana Fuss (New York: Routledge, 1991), 13–31.
[3] On the emancipatory possibility of failure, see Jack Halberstam, *The Queer Art of Failure* (Durham, NC: Duke University Press, 2011).

shown, is both a product of and producer of history.[4] As Homi Bhabha has shown, masculinity is an "ambivalent identification," one that is always "oscillating."[5] In the nineteenth century, numerous varieties of white masculinity jostled for supremacy. M. Jacqui Alexander argues that this period "witnessed an ongoing struggle for power among different kinds of white masculinities." Catherine Hall, too, has shown how different masculinities were in competition with one another.[6] The competitive, multivalent nature of masculinity was formative to mining engineers' aspirations to manliness.

The first "hole" had to do with engineers' place between capital and labor. As David Noble and others have shown, engineers functioned as the "common medium" connecting "scientific technology and corporate capitalism," in the late nineteenth century US.[7] In her essential account of "the most male-dominated profession of all," Ruth Oldenziel shows how late nineteenth century engineers were anxious of their social position. Although engineers functioned as the "shock troops of industrial capitalism," and "intellectuals, artists, and social scientists endowed them with great cultural meaning and importance, many engineers felt misunderstood, disrespected, and undervalued." Faced with pressure from above and below, engineers "suffered from existential anxieties what it meant to be an engineer and where the boundaries of its knowledge domain lay."[8] In the case of mining engineers, this pressure from

[4] R. W. Connell, *Masculinities*, Second edition (Berkeley: University of California Press, 2005), 67–86. For an argument on the necessity of African-centered theories of masculinity, see Sakhumzi Mfecane, "Towards African-Centred Theories of Masculinity," *Social Dynamics* 44, no. 2 (2018): 291–305.
[5] Homi K. Bhabha, "Are You a Man or a Mouse?," in *Constructing Masculinity*, ed. Maurice Berger, Brian Wallis, and Simon Watson (New York: Routledge, 1995), 57–65.
[6] Catherine Hall, "Competing Masculinities: Thomas Carlyle, John Stuart Mill and the Case of Governor Eyre," in *White, Male and Middle-Class: Explorations in Feminism and History* (Cambridge: Polity Press, 1992), 255–95.
[7] David F. Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (New York: Alfred A. Knopf, 1977), *xvii*. More generally, see Noble's account of the rise of the professional engineer in *America by Design*, 88–117.
[8] Oldenziel, *Making Technology Masculine*, 51, 91.

above could come from mine owners as well as the wealthier, successful, and often older members of the profession who had greater independence. From below, it came from mineworkers.

In the sites under consideration here, as well as almost everywhere mining engineers operated, masculinity was contested and performed in a (settler) colonial context.[9] As Jonathan Saha has shown of British Burma, in colonial contexts, masculine whiteness was something implicit and unstated. In other words, it was not something that could be named but rather was defined against feminized, non-white bodies.[10] As Mrinalini Sinha has shown for nineteenth century South Asia, a "focus on colonial masculinity" reveals the "multiple axes of domination and subordination" in a colonial society "as a whole."[11] As the example of Summerhayes illustrates, however, and as this chapter will show, masculinity was often threatened rather than self-possessed. Warwick Anderson's work on colonial Philippines and Australia shows that white masculinity functioned less as an identity than an instrument of rule and subjugation. As Anderson terms it, masculine whiteness operated as a "strategy of authority." Nevertheless, as

[9] As Scott Lauria Morgensen has powerfully shown, heteropatriarchy is itself a colonial project. Scott Lauria Morgensen, *Spaces between Us: Queer Settler Colonialism and Indigenous Decolonization* (Minneapolis: University of Minnesota Press, 2011). Scholarship on settler masculinity in southern Africa has focused largely on colonial Natal. See Robert Morrell, *From Boys to Gentlemen: Settler Masculinity in Colonial Natal, 1880-1920* (Pretoria: Unisa Press, 2001); T. J. Tallie, *Queering Colonial Natal: Indigeneity and the Violence of Belonging in Southern Africa* (Minneapolis: University of Minnesota Press, 2019). Works that consider masculinity in relation to US imperial expansion include Amy S. Greenberg, *Manifest Manhood and the Antebellum American Empire* (New York: Cambridge University Press, 2005); Monica Rico, *Nature's Noblemen: Transatlantic Masculinities and the Nineteenth-Century American West* (New Haven, CT: Yale University Press, 2013); Honor Sachs, *Home Rule: Households, Manhood, and National Expansion on the Eighteenth-Century Kentucky Frontier* (New Haven, CT: Yale University Press, 2015); Victor Román Mendoza, *Metroimperial Intimacies: Fantasy, Racial-Sexual Governance, and the Philippines in U.S. Imperialism, 1899-1913* (Durham, NC: Duke University Press, 2015).

[10] Jonathan Saha, "Whiteness, Masculinity and the Ambivalent Embodiment of 'British Justice' in Colonial Burma," *Cultural and Social History* 14, no. 4 (2017): 527–42.

[11] Mrinalini Sinha, *Colonial Masculinity: The "manly Englishman" and the "Effeminate Bengali" in the Late Nineteenth Century* (Manchester: Manchester University Press, 1995), 11–12.

it functioned at sites of "corporeal unease and conflict with others," it was also deeply anxious. Anderson argues that there was simply no way that masculine whiteness could live up to its idealized form:

> The emerging white man often seems a melancholy or nostalgic character. Frequently a troubled soul, he could be more an itinerant than cosmopolitan, a figure of pathos as much as hubris. Emerging at sites of environmental stress and group conflict, he appears always in flux, always becoming, imperiled, anxious, messing up, and breaking down. Prone to outbursts of anger and frustration, and often full of self-pity and nervousness, the white man rarely presented a compelling model of self-possession and control. Few diasporic whites would have recognized as their own the commanding, hardy white bodies and mentalities that politicians and scientists were busily constructing and mobilizing.

Anderson's description of the "emerging white man" accurately describes much about mining engineers. Indeed, itinerant mining engineers frequently idolized their early "heroes" who operated in a simpler time. Moreover, environmental stress, conflict, violence all characterized the extractive sites at which they operated.[12]

Extractive sites themselves have long been deeply masculine spaces, among the most extreme examples of heteropatriarchy.[13] Mining towns in the nineteenth century were commonly known to be masculine spaces, full of brave, risk-taking miners. These were places frequently home to violence in the form of robberies or labor unrest, a considerable presence

[12] Warwick Anderson, "The Trespass Speaks: White Masculinity and Colonial Breakdown," *American Historical Review* 102, no. 5 (December 1997): 1343–70; Warwick Anderson, "Traveling White," 65–72. Also see Warwick Anderson, *The Cultivation of Whiteness: Science, Health and Racial Destiny in Australia* (Carlton, Vic.: Melbourne University Press, 2002); Warwick Anderson, *Colonial Pathologies: American Tropical Medicine, Race, and Hygiene in the Philippines* (Durham, NC: Duke University Press, 2006); Warwick Anderson, "Coolie Therapeutics: Labor, Race, and Medical Science in Tropical Australia," *International Labor and Working-Class History* 91 (2017): 46–58.

[13] Julia Ann Laite, "Historical Perspectives on Industrial Development, Mining, and Prostitution," *Historical Journal* 52, no. 3 (September 2009): 739–61; Sarah Bradshaw, Brian Linneker, and Lisa Overton, "Extractive Industries as Sites of Supernormal Profits and Supernormal Patriarchy?," *Gender & Development* 25, no. 3 (2017): 439–54; Kuntala Lahiri-Dutt, "Feminising an Ancient Human Endeavour: Gendered Spaces in Mining," in *Making Sense of Mining History: Themes and Agendas*, ed. Stefan Berger and Peter Alexander (Abingdon, UK: Routledge, 2020), 173–92; Thomas Hendriks, *Rainforest Capitalism: Power and Masculinity in a Congolese Timber Concession* (Durham, NC: Duke University Press, 2022).

of sex workers, heavy drinking, and gambling—in all, about the most removed from bourgeois respectability that a settler town could be.[14] Although recently historians of mining have begun to challenge that conception by showing that women miners have been undercounted and ignored by historians, the general pattern is true.[15] The "rough and masculine" world frequently situated "on the edge of empire," as Adele Perry has written of mid-nineteenth century British Columbia, was alternately the "harbinger of [settler] civilization" or the site of "miners "sexual and social excess."[16] This world served as the backdrop for mining engineers' performance of masculinity.

Writing on a very different setting—the antebellum southern plantation—in *Black Reconstruction*, W. E. B. Du Bois wrote in his chapter on wrote of southern planters—who were almost exclusively men—that "the psychological effect of slavery upon him was fatal." Planters' legal authority and power over others "tended to inflate the ego of most planters beyond all

[14] Gunther Peck, "Manly Gambles: The Politics of Risk on the Comstock Lode, 1860-1880," *Journal of Social History* 26, no. 4 (Summer 1993): 701–23; Ronald M. James and Elizabeth Raymond, eds., *Comstock Women: The Making of a Mining Community* (Reno: University of Nevada Press, 1998); Susan Lee Johnson, *Roaring Camp: The Social World of the California Gold Rush* (New York: W. W. Norton, 2000); Adele Perry, *On the Edge of Empire: Gender, Race, and the Making of British Columbia, 1849-1871* (Toronto: University of Toronto Press, 2001); Clare Sears, "All That Glitters: Trans-Ing California's Gold Rush Migrations," *GLQ: A Journal of Lesbian and Gay Studies* 14, no. 2–3 (2008): 383–402; Christopher Herbert, *Gold Rush Manliness: Race and Gender on the Pacific Slope* (Seattle: University of Washington Press, 2018). On South Africa, see Zackie Achmat, "'Apostles of Civilised Vice': 'Immoral Practices' and 'Unnatural Vice' in South African Prisons and Compounds, 1890–1920," *Social Dynamics* 19, no. 2 (1993): 92–110; Keith Breckenridge, "The Allure of Violence: Men, Race and Masculinity on the South African Goldmines, 1900-1950," *Journal of Southern African Studies* 24, no. 4 (December 1998): 669–93; Ross G. Forman, "Randy on the Road: Portuguese African Labor and the Discourse on 'Unnatural Vice' in the Transvaal in the Early Twentieth Century," *Journal of the History of Sexuality* 11, no. 4 (October 2002): 570–609; Charles van Onselen, *The Fox and the Flies: The World of Joseph Silver, Racketeer and Psychopath* (London: Jonathan Cape: 2007), Charles van Onselen, *Showdown at the Red Lion: The Life and Times of Jack McLoughlin, 1859-1910* (Johannesburg: Jonathan Ball, 2015).

[15] Jaclyn Gier and Laurie Mercier, eds., *Mining Women: Gender in the Development of a Global Industry, 1670-2005* (Basingstoke, UK: Palgrave Macmillan, 2009); Rossana Barragán Romano and Leda Papastefanaki, "Women and Gender in the Mines: Challenging Masculinity Through History: An Introduction," *IRSH* 65 (2020): 191–230; Lou Haysom, "Petticoats and Pickhandles: Suffrage and Socialism in Gendered Resistance to Empire and Mining Capitalism," *Agenda* 34, no. 4 (2020): 12–24.

[16] Perry, *Edge of Empire*, 32, 46.

reason; they became arrogant, strutting, quarrelsome kinglets; they issued commands; they made laws; they shouted their orders; they expected deference and self-abasement; they were choleric and easily insulted." While weak, ineffectual planters were "all the more easily angered, jealous and resentful," "the few who were superior, physically or mentally, conceived no bounds to their power and personal prestige."[17] Du Bois' own views on gender issues, including his emphasis on black manhood, have been discussed at length.[18] Joy James argues that "Du Bois's profeminist politics clearly marks his opposition to patriarchy and misogyny," while "a masculinist worldview influences his writing," and "he holds on to a masculinist framework that presents the male as normative."[19] I argue that mining engineers displayed similar behaviors to Du Bois' planters, and their hold on masculinity was similarly fragile.

Mining engineers attempted to overcome the anxiety stemming from occupying this liminal, ambiguous, space in between by creating, fashioning, and attempting to assert their masculinity. Their response required careful triangulation between asserting an especially rugged form of masculinity and demonstrating the middle-class sophistication they either aspired to or feared losing.

This chapter first considers how mining engineers' masculinity was imagined in popular and romantic imperialist fiction in the period. Novelists set a high bar for aggressive masculinity

[17] Du Bois, *Black Reconstruction*, 52–53.
[18] Kim Townsend, *Manhood at Harvard: William James and Others* (New York: W. W. Norton, 1996), 246–55; Hazel V. Carby, *Race Men* (Cambridge, MA: Harvard University Press, 1998), 9–41, Monica L. Miller, "W. E. B. Du Bois and the Dandy as Diasporic Race Man," *Callaloo* 26, no. 3 (2003): 738–65. For analyses of women and gender in *Black Reconstruction*, see Thavolia Glymph, "Du Bois's Black Reconstruction and Slave Women's War for Freedom," *South Atlantic Quarterly* 112, no. 3 (Summer 2013): 489–505; Alys Eve Weinbaum, "Gendering the General Strike: W. E. B. Du Bois's *Black Reconstruction* and Black Feminism's 'Propaganda of History'," *South Atlantic Quarterly* 112, no. 3 (Summer 2013): 437–63. Also see the essays collected in Susan Gillman and Alys Eve Weinbaum, eds., *Next to the Color Line: Gender, Sexuality, and W. E. B. Du Bois* (Minneapolis: University of Minnesota Press, 2007).
[19] Joy James, *Transcending the Talented Tenth: Black Leaders and American Intellectuals* (New York: Routledge, 1997), 35–36.

that many engineers tried, but failed, to live up to. The chapter then considers how university education and growing professionalization posed a challenge to engineers working in the field alongside and over working-class miners and did so in deeply homosocial spaces. The chapter then considers the numerous ways engineers attempted to embody and perform gendered expectations. Finally, the chapter concludes by considering the essential but overlook and underacknowledged role of women in supporting the careers of mining engineers.

Cultural Representations: Mining Engineers in Fiction

The "white fantasy" of "absolute power" had to be imagined before it could be materialized.[20] Fiction served several purposes: not only did mining engineers figure largely in the popular, romanticized imperial adventured tales of the late nineteenth and early twentieth century, offering a heroic image to the reading public, but fiction both inspired and was inspired by mining engineers. Herbert Hoover, for instance, recalled loving Walter Scott's 1819 romantic tale set in the Crusades, *Ivanhoe*, as well as Charles Dickens, while a child in Iowa.[21] While it was beyond the scope of my research to delve deeply into the leisure time reading habits of mining engineers, there are eerie echoes of H Rider Haggard's heroes in many of their behaviors and pronouncements. More popularly, Clark Spence describes mining engineers' depiction in popular fiction as the stereotypical "personification of manliness."[22] More broadly, in the United States in the 1890s, as Amy Kaplan has shown, newly popular nostalgic, "swashbuckling romances" that appeared in the wake of the closing of the frontier "offer a

[20] Catherine Hall, "Gendering Property, Racing Capital," *History Workshop Journal* 78, no. 1 (Autumn 2014), 29. On imagining imperial masculinity through fiction, see Graham Dawson, *Soldier Heroes: British Adventure, Empire and the Imagining of Masculinities* (Abingdon, UK: Routledge, 1994).
[21] Hoover, *Years of Adventure,* 13.
[22] Spence, *Mining Engineers and the American West*, 318.

cognitive and libidinal map of the geopolitical shift from continental expansion to overseas empire."[23] In North America, Britain, and southern Africa, fiction showcased both the threats to engineers' masculinity and functioned as inspiration and outlet for masculinity's expression.

Mining engineers as avatars of rugged individuality find the clearest expression in Richard Harding Davis's 1897 novel about a coup in a South American republic, *Soldiers of Fortune*.[24] First serialized in *McClure's*, the novel extols the many virtues of engineers and laments their lack of appropriate recognition. One character describes engineers as "the bravest soldiers of the present day, and they are the least recognized. I have forgotten their names, and you never heard them. But it seems to me the civil engineer, for all that, is the chief civilizer of our century."[25] The novel's engineer, Robert Clay, wore a sombrero and was "covered […] with dust and perspiration." Strong and attractive, Clay was capable of "doing the work of five men and five different kinds of work," all "without grumbling" and with an "ease of manner." Clay believed that "the engineer's work is all the more absorbing […] when the difficulties are greatest. He has the fun of overcoming them."[26]

Clay was in fact was based on the real-life mining engineer John Hays Hammond.[27] Clay's filibustering in South America was possibly inspired by Hammond's involvement in the Jameson Raid, a failed attempt to bring the South African Republic's gold under British control

[23] Kaplan, *Anarchy of Empire*, 94.
[24] Richard Harding Davis, *Soldiers of Fortune* (Peterborough, ON: Broadview Editions, 2006 [1897]). Also see Oldenziel, *Making Technology Masculine*, 123–24.
[25] Davis, *Soldiers of Fortune*, 49.
[26] Davis, *Soldiers of Fortune*, 50.
[27] Spence, *Mining Engineers and the American West*, 319; Van Onselen, *Cowboy Capitalist*, 347–56.

in 1895.[28] There was another overlap between fiction and reality in Hammond, who knew the popular novelist of the mid-nineteenth-century US west, Bret Harte, personally.[29] In Johannesburg of the 1890s, "Harte's novels were so well known that the police magistrate referred to them in open court and local newspaper reports often alluded to the American writer."[30] As Hammond was seeking political office he attempted to distance himself from those days, writing that in Johannesburg's mining community "it was both easy and agree able to transfer to South Africa the wild life of Red Gulch and to fill the stage with a lawless and violent mob which, in the intervals between working their claims and murdering one another, found time to drink, to gamble and, occasionally, to sleep."[31] The reality was quite different, Hammond argued, given that "Johannesburg was much more like a wealthy manufacturing town than a traditional mining camp."[32] Regardless of how much or little reality corresponded to fiction, Hammond's protestations are revealing of the gap between the popular ideal and reality. Moreover, the connection demonstrates that life did not simply imitate art, but that there were lived connections between the two.

The fact that the days of Harte's prospectors were over was apparent to San Francisco-born novelist Jack London. London sailed for the Klondike in 1897 at age 21, along with approximately a hundred thousand other gold-seekers in what was famously the "last gold rush." London, like most, failed to find riches. By 1900, London celebrated the role of the

[28] On filibustering, see Robert E. May, *Manifest Destiny's Underworld: Filibustering in Antebellum America* (Chapel Hill: University of North Carolina Press, 2002). On filibustering's entanglements of masculinity, whiteness and capitalism, see Johnson, *River of Dark Dreams*, 304–94.
[29] Hammond, *Autobiography*, 1:31; Francis Bret Harte, *The Luck of Roaring Camp and Other Sketches* (Boston: Fields, Osgood, 1870).
[30] Van Onselen, *Cowboy Capitalist*, 47.
[31] The setting of one of Harte's short stories, "The Idyl of Red Gulch," in Harte, *Luck of Roaring Camp*, 72–88.
[32] John Hays Hammond, *The Truth about the Jameson Raid* (Boston: Marshall Jones, 1918), 12–13.

engineer in bringing progress to the gold fields: “though many of its individuals have lost, the world will have lost nothing by the Klondike.” The “the Klondike of the future” would be efficient, orderly, and modern:

> Natural obstacles will be cleared away or surmounted, primitive methods abandoned, and hardship of toil and travel reduced to the smallest possible minimum. Exploration and transportation will be systematized. There will be no waste energy, no harum-scarum carrying on of industry. The frontiersman will yield to the laborer, the prospector to the mining engineer, the dog-driver to the engine-driver, the trader and speculator to the steady-going modern man of business; for these are the men in whose hands the destiny of the Klondike will be entrusted.[33]

London’s first novel, *A Daughter of the Snows*, features a mining engineer as a central character. A romance in which Frona Welse is choosing between two suitors, Welse chooses Corliss. The plot involves Welse primitivizing Corliss, described as “a very learned young man, with a Freiberg mining engineer's diploma and a B. A. sheepskin from Yale.” Overly refined and educated, Corliss was said to have sturdier, tougher ancestry that was only waiting to be brought to the surface: “he had not become hardened in the mould baked by his several forbears and into which he had been pressed by his mother's hands. Some atavism had been at work in the making of him, and he had reverted to that ancestor who sturdily uplifted. But so far this portion of his heritage had lain dormant. He had simply remained adjusted to a stable environment.”[34] Kathryn Morse argues that London was echoing the arguments of Frederick Jackson Turner’s 1893 essay about the closing of the US frontier.[35]

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[33] Jack London, “The Economics of the Klondike,” *American Monthly Review of Reviews* 21 (January 1900), 74.
[34] Jack London, *A Daughter of the Snows* (Philadelphia: J. B. Lippincott, 1902).
[35] Morse, *Nature of Gold*, 194–99. On Turner and the myth of the frontier in this period, see Richard Slotkin, *Gunfighter Nation: The Myth of the Frontier in Twentieth-century America* (Norman: University of Oklahoma Press, 1991), 29–62.

It is no accident that, in the English-speaking world during the age of empire, the most popular and significant poet of empire *and* of engineers were the same person: Rudyard Kipling. In the words of Bill Schwarz, Kipling's poetry contains "a mystical, and highly abstract, projection of the ideals of white civilization."[36] Where better to look for a potent symbol of white masculinity—the supposed virtues of which empire depended on—than mining engineers?[37] One of Kipling's early works that signaled his interest in extraction, engineering, and Anglo-American empire was his 1892 novel *The Naulakha: A Story of East and West.* The plot of the novel revolves around Nicholas Tarvin, a US mining engineer from the fictional town of Topaz, Colorado, who travels to the "desert of Rajputana" in India.[38]

Far better known than *The Naulakha* is Kipling's circa 1895 tribute to Leander Starr Jameson, "If—."[39] Inspired by Jameson's involvement in the Jameson Raid, *If—* is widely seen as a paragon of imperial stoicism in the face of adversity. While Kipling is known for his admiration of Jameson and close friendship with Cecil Rhodes, whom he often visited in the Cape, of the imperialists in southern Africa it was Hammond who first made acquaintance with Kipling, and who connected Rhodes and Kipling.[40] The poem promises rewards to those who can maintain self-possession: "If you can keep your head when all about you Are losing theirs" and "If you can trust yourself when all men doubt you," "Then the world is yours for the taking." But

[36] Bill Schwarz, *Memories of Empire: The White Man's World* (Oxford: Oxford University Press, 2011), 98.
[37] Schwarz, *Memories of Empire*, 181.
[38] Rudyard Kipling, *The Naulakha: A Story of West and East* (New York: Doubleday and McClure, 1899), 69.
[39] Rudyard Kipling. "If — " in *Rewards and Fairies* (London: Doubleday, Page, 1910), 181–82; Chris Ash, *The If Man: Dr Leander Starr Jameson, the Inspiration for Kipling's Masterpiece* (Solihull, UK: Helion, 2012). For an important consideration of the poem's contemporary place in South Africa as it relates to sexual violence, see Lucy Graham, "'Then You Are a Man, My Son': Kipling and the Zuma Rape Trial," *Comparative Studies of South Asia, Africa and the Middle East* 36, no. 2 (2016): 263–74.
[40] Van Onselen, *Cowboy Capitalist*, 355. On Hammond and other Jameson Raid conspirators in fact and fiction see 347–56.

beyond promising the world—"Yours is the Earth and everything that's in it" it's the promise of manliness that is the ultimate reward that the final stanza guarantees: "And—which is more—you'll be a Man, my son!"

While *If*—promises the world in much the same way that Du Bois said it whiteness did in *Darkwater*, Kipling's best known tribute to engineers, the 1907 poem *The Sons of Martha*, is a middle-class vision of tireless, endless work. Unlike the Sons of Mary, the Sons of Martha "wait upon Mary's Sons, world without end, reprieve or rest." Engineers—not named in the poem—nevertheless possess a remarkable power that goes unrecognized:

> They say to mountains, 'Be ye removed.' They say to the lesser floods, 'Be dry.'
> Under their rods are the rocks reproved — they are not afraid of that which is high.
> Then do the hill-tops shake to the summit — then is the bed of the deep laid bare,
> That the Sons of Mary may overcome it, pleasantly sleeping and unaware.[41]

The Sons of Martha, along with Kipling's remarkably "planetary reputation," was behind H. E. T. Haultain, a professor of mining engineering at the University of Toronto, to ask Kipling in 1922 to help write "The Ritual of the Calling of an Engineer."[42] A moral oath for engineering graduates first used in 1925, it is still in use at many Canadian universities. "My time I will not refuse; my thought I will not grudge; my care I will not deny towards the honour, use, stability and perfection of any works to which I may be called to set my hand."[43]

Kipling, too, encouraged his friend, the South African mine magnate Percy FitzPatrick, to write the novel that best weaves together these threads of masculinity, extraction, and mobility. Having heard FitzPatrick tell his children about his adventures in the 1880s Lowveld,

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[41] Oldenziel, *Making Technology Masculine*, 125–31.
[42] Elleke Boehmer, "The Text in the World, The World Through Text: Robert Baden-Powell's Scouting for Boys," in *Ten Books That Shaped the British Empire: Creating an Imperial Commons*, ed. Antoinette Burton and Isabel Hofmeyr (Durham, NC: Duke University Press, 2014), 145.
[43] Camp One Toronto, "The Calling of an Engineer," https://www.camp1.ca/wordpress/?page_id=2.

Kipling suggested FitzPatrick put them down on paper. The result was the 1907 novel *Jock of the Bushveld*, about a Staffordshire terrier named "Jock" who accompanies the protagonist hunting various animals in the veld. FitzPatrick dedicated *Jock of the Bushveld* to "the likkle people," (sic) and among white South African children it has long been a classic. As the Johannesburg *Star* argued upon the book's publication, "*Jock* is not primarily a book about dogs. Nor is it a child's book, in spite of its dedication. Principally it is a story of men for men."[44] FitzPatrick was a central player in the Jameson Raid of 1895 and was intimate with many of the key mining engineers on the Rand. It was in this context of professional, educated men involved in gold extraction that looking to the previous generation of mining men made sense.

Jock features a character, known only as "Rocky Mountain Jack," who may well have been inspired in part by Hammond.[45] The narrator's description of Rocky, though an aging an unsuccessful prospector, has parallels with the real life highly mobile career of Hammond: there was no "known region of the earth where prospectors roam" that Rocky had not visited. FitzPatrick describes Rocky's Americanness as undiminished, however, as "whilst gleaning something from every land, his native flavour clung to him unchanged." Referring to the most popular fictional chronicler of the US west, Rocky seemed to have appeared straight "out of the pages of Bret Harte." Reflecting on Rocky's misfortune at prospecting, FitzPatrick emphasized that Rocky seemed to have achieved success on his own terms, as his fair dealing, independence, bravery, and masculinity lived up to his own ideal: "Rocky had taken the world as it is and backed himself against it—living up to his ideal, playing a 'lone hand' and playing it

[44] *Star* (Johannesburg), 1 November 1907.
[45] Van Onselen, *Cowboy Capitalist*, 47, 485n22.

fair in all conditions, treading the unbeaten tracks, finding his triumph in his work, always moving on and contented so to end: the crown, 'He was a man!'—then surely Rocky's had achieved success!" The narrator admits that Rocky may have been "a bit idealised," but considers this beside the point: "Perhaps so: but who can say!"[46] The truth was no matter because, in any case, Jock and Rocky had much to teach white South African men, young or old. Rocky's "quiet unhesitating sureness" and "definiteness of purpose" were a source of confidence and fodder for "visions of exciting chases and glorious endings."[47] More than Rocky, it is Jock who represents the worst elements of mining masculinity: apparently, "Jock disliked kaffirs," and the novel's moral message of duty, loyalty, and aggressiveness are encapsulated in the ending when Jock dies. The narrator only wished that he had died fighting a lioness on the last day of their hunting, or "like [British admiral Horatio] Nelson—in the hour of victory." At least, he hoped, Jock died "hanging on with his indomitable pluck and tenacity, tackling something with all the odds against him; doing his duty and his best as he had always done—and died as Rocky's dog had died." As it happened, Jock died defending his owner's chicken coop from a "kaffir dog."[48] Much like the fictional Jock, mining engineers were commonly depicted as dogged, loyal, and independent. In other words, writers imagined them as everything white masculinity aspired to be but never could attain.

[46] J. Percy FitzPatrick, *Jock of the Bushveld* (Johannesburg: Penguin, 2007); 25–26; Stephen Gray, "Domesticating the Wilds: Percy FitzPatrick's Jock of the Bushveld as a Historical Record for Children," *English in Africa* 14, no. 2 (October 1987): 1–14.
[47] FitzPatrick, *Jock*, 27.
[48] FitzPatrick, *Jock*, 347–48.

Education and Masculinity

For most mining engineers, the first place they were exposed to the ideals of their profession was during their training. In the later decades of the nineteenth century, it was increasingly necessary for mining engineers to acquire a university education.[49] In the United States, engineering schools for any branch of engineering were overwhelmingly white and male spaces in this era.[50] However, during the 1850s and 1860s especially, before US mining engineering schools took off, but throughout the last decades of the century, university-trained engineers struggled to defend the skills they had acquired not at the mine but in the classroom. These struggles and anxieties were frequently commented on by engineers, and, in later years, celebrated overcoming them. Despite its renown within mining and metallurgy circles—Hammond accurately if grandiosely described it as to mining and metallurgy what Heidelberg and the Sorbonne were to literature—Freiberg graduates were commonly held in low regard for their theoretical knowledge and perceived lack of practical training. Upon Hammond's return from Europe in 1897, he sought out a job in San Francisco, inquiring with a friend of his father's, future senator George Hearst. Hearst initially rebuffed Hammond, telling him, "The fact of the matter is, Jack, you've been to Freiberg and have learned a lot of damn geological theories and big names for little rocks. That don't go in this country." Asked if Hearst had any other objects, Hearst replied, smiling, "Freiberg is enough." Only by telling Hearst that in fact he

[49] For an overview of US mining engineering education, see Spence, *Mining Engineers and the American West*, 18–53.

[50] The few exceptions were likely errors in recording. See Amy Sue Bix, *Girls Coming to Tech!: A History of American Engineering Education for Women* (Cambridge, MA: MIT Press, 2014), 29–54. For an overview of gender in US engineering in this period, see Lisa M. Frehill, "The Gendered Construction of the Engineering Profession in the United States, 1893–1920," *Men and Masculinities* 6, no. 4 (April 2004): 383–403. On racial exclusion in a later period of US engineering education, see Amy E. Slaton, *Race, Rigor, and Selectivity in U.S. Engineering: The History of an Occupational Color Line* (Cambridge, MA: Harvard University Press, 2010).

had not learned anything at all at Freiberg did Hammond secure a job.[51] Similar attitudes held nearly two decades later. Hoover wrote of his time in Nevada City and Grass Valley, California, between 1895 and 1897 that Cornish managers were skeptical of "them college educated fellers," like himself, and credited Cornish miners with teaching him the tricks of the trade.[52] In the same period, Freiberg could still earn an engineer derision, as it did in the Yukon, where a guide for prospectors cautioned that for overly confident "tenderfoot" prospectors, "The 'tip' of a Freiberg expert on the Yukon isn't worth the icicles on his Vandyke."[53] Overcoming the perception that engineers were too effeminate by virtue of their education and lack of practical experience could be a cause for celebration, as it was at a dinner of engineers on October 22, 1898, in Johannesburg. There, Theodore Reunert, an English engineer who had been in South Africa since 1879, proposed a toast to the "mining industry," in recognition of "the many benefits which it conferred upon the engineering profession." Reunert recalled that "Old Kimberleyites would remember that the engineer was at one time regarded with suspicion. It was once the general impression that the ordinary practical man who could master a few words of Kaffir and Dutch was quite good enough to control mining operations." The "practical man" had nevertheless "made a mess of things," producing "ungainly and unsightly work which should never have been done."[54] By this time, anxiety had given way to arrogance, at least on the Rand.

[51] Hammond, *Autobiography*, 1:84–85.
[52] Hoover, *Years of Adventure*, 25–26.
[53] A. C. Harris, *Alaska and the Klondike Gold Fields* (Chicago: Monroe Book Company, 1897), 127–28.
[54] "Annual Dinner," *Proceedings of the South African Association of Engineers and Architects*, 5, 13.

Anxiety In-between Capital and Labor on the Mines

An essential feature of engineers in this period, as well as a source of anxiety, was their place in between management and labor, and as managers of the latter. This liminal position for engineers in the United States is rooted in the canal construction projects of the 1830s and 1840s, as Peter Way has shown. Way's description of this relationship aptly characterizes engineers' position even in the later nineteenth century: "Ostensibly disinterested professionals charged with ensuring the quality and economy of the work, engineers also functioned as enforcers of the board's will, often at the expense of contractors and labourers." This tension was a result of engineers' role "As the eyes, ears and minds of management, they were responsible for melding men and technology into a well-oiled excavating machine. Yet their actual power was moderated by the anomalous position created for them by upper management."[55]

The early experiences of Ira Joralemon, a mining engineer and economic geologist specializing in copper, demonstrate how mining engineers simultaneously genuflected to rougher "old timers" who lacked formal training while asserting their own superiority. Joralemon held two mining and metallurgy degrees from Harvard, the last of which he earned in 1907. Around 1910, Joralemon was in Arizona, prospecting for copper near what became the Ajo mine. Far from any accommodations, Joralemon and four other engineers had to eat at the boarding house of the Swedish drill men from Minnesota. Joralemon described these men as

[55] Peter Way, *Common Labour: Workers and the Digging of North American Canals, 1780-1860* (Cambridge: Cambridge University Press, 1993), 57–59. For engineers' similar position in the late nineteenth century, see Peter Whalley, *The Social Production of Technical Work* (London: Palgrave Macmillan, 1986); Peter Whalley, "Negotiating the Boundaries of Engineering: Professionals, Managers, and Manual Work," *Research in the Sociology of Organizations* 8 (1990), 191–215; Logan Hovis and Jeremy Mouat, "Miners, Engineers, and the Transformation of Work in the Western Mining Industry, 1880-1930," *Technology and Culture* 37, no. 3 (July 1996): 429–56.

“so tough that the squaw men around Ajo, who lived with their Papago families out in the desert called the Swedes ‘the savages.’” The “Chinese cook paid no attention to getting anything decent,” with the result that the “food was a mass of flies.” Despite the unpalatable sustenance, Joralemon proclaimed it “another tribute to education” that the five engineers “who had to compete with the Swedes and with the miners in getting enough to eat” each “gained 3 or 4 pounds in the six weeks of sampling.” While on one hand Joralemon was proud of outsmarting “savage” Swedish drill men, he also expressed a mix of affection and superiority over some “old timer” miners. Joralemon had brought with him two “top notches,” Bob Lyons and Ed McLean, who functioned as something like foremen. Joralemon described Lyons, a strike breaker in Cripple Creek, Colorado during the labor uprisings between 1905 and 1908, as “probably the toughest miner whoever came to Bisbee.” Joralemon distanced himself only slightly from Lyons at the same time as he was impressed with his masculine bravado: Lyons was “always just looking for trouble”—something a respectable mining engineer would never admit to—but was at the same time “a good friend” to Joralemon and “a very fine fellow.” McLean, by contrast, was less aggressive but still “had all the nerve in the world.” Joralemon acknowledged that McLean, a miner who “hadn't had much of an education,” nevertheless “had learned to be something of an engineer” and “could do absolutely anything.” Of all the characters Joralemon met in the desert, it was the camp cook, Jim Manning, “who had a perfectly fantastic life.” Describing Manning as a “75-year old ex-everything,” Joralemon plainly longed—or wanted to appear to long for—the romantic adventures of the former Confederate Army scout. Joralemon breathlessly related Manning’s tales of fighting across Texas and into Mexico after the “Confederates folded” as the Civil War ended in 1865. In Mexico, Manning

was "good friend" and bodyguard to Emperor Maximilian I until Maximilian's death in 1867.[56] As Sheriff of El Paso and a Texas Ranger during the 1870s and 80s, Manning was "an Indian fighter and kept good order." Jorelemon regarded it as tragic that, in the twentieth century, Manning's time appeared to be up. Manning sold his Texas cattle for Los Angeles racehorses, and soon found racing "too much of a game and he lost all his money." Forced to "come back to the desert," Manning "gradually sunk lower and lower, until finally, at 75 years of age, he was cooking in this terrifically hot camp, for 6 prospectors on the Colorado River." Along with his cohort of other trained engineers, it was now Joralemon's time to come to prominence as Manning once had.[57]

Performing Strenuous Masculinity on the Edge of Empire

If there was one mining engineer that the field collectively looked up to, who personified their combined ideals of energy, vision, physicality, and mathematical talent—the most masculine of men—it was Hamilton Smith, Jr. Self-educated in the library of his father's house in Cannelton, Indiana, where Smith Sr. operated a coal mine and cotton mill, Smith was the consulting engineer for the English branch of the Rothschild banking family.[58] As Smith's friend Henry Perkins said of him, "Mr. Smith was cast in a large mold. In his physical aspect he suggested the sturdy old Vikings. His strong benevolent countenance and large bearing caught the attention of those whom he met." Perkins continued:

[56] On Americans in Mexico in this period, see John Mason Hart, *Empire and Revolution: The Americans in Mexico since the Civil War* (Berkeley: University of California Press, 2002), 9–45.
[57] Ira B. Joralemon, "Reminiscences of Ira Beaman Joralemon: oral history, 1961," Columbia Center for Oral History. On Joralemon also see Roediger and Esch, *Production of Difference*, 115–16.
[58] "Gallery of Industry and Enterprise: Hamilton Smith, of Kentucky," *DeBow's Review*, July 1851, 90; Robert Vicat Turrell and Jean-Jacques van Helten, "The Rothschilds, The Exploration Company and Mining Finance," *Business History* 28, no. 2 (April 1986): 181–205.

> Rarely are united in one individual such powerful qualities of both mind and heart. In his father's library and in the various undertakings at Cannelton, Ind., the son acquired a broad and varied education. His energy and thoroughness were such that these qualities, aided by a clear vision, would have carried him to the front in any profession he might have adopted. He saw clearly and acted fearlessly. As an engineer, he was constructive; and upon looking at a proposition he soon saw the desired end and the best method of reaching it, while a forceful will carried him in the most direct path with extraordinary rapidity.[59]

Hennen Jennings recalled that although Smith was "largely self-educated, his scholarly book on hydraulics, published in 1886, showed that he was a master in theoretical mathematics. His honesty of purpose won confidence, and he was eminent among mining men both in this country and in Europe." Jennings learned a great deal from Smith, who "planned with daring and thoroughness." [60] Elsewhere Perkins said that Smith's "figure bulks largest among the mining engineers I have known."[61] In many ways these engineers were nostalgic for the era in which Smith operated, but he served as an ideal long after his prime of the 1870s to early 1890s.

Most engineers were more outwardly modest than Hoover, who wrote of his time in California's mountainous Yosemite Valley as a Stanford University undergraduate, that those "summers of hard physical exertion in the mines and the mountains blessed me with a physique equal to any subsequent exertion."[62] Still, most were keen to prove their strength in any number of ways, from wartime heroism, subjugating indigenous people, surviving difficult and dangerous environments, and hunting big game animals.

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[59] Union B. White, "America's Greatest Gold-Mining Engineer a Native of Louisville," *Courier-Journal* (Louisville), August 30, 1908.
[60] Rickard, *Interviews*, 226.
[61] Rickard, *Interviews*, 414.
[62] Hoover, *Years of Adventure*, 20.

During the South African War of 1899-1902, most of the US engineers on the Rand or in Kimberley left southern Africa, contrary to the popular image of the fictional mining engineer and mercenary Robert Clay depicted in Davis' *Soldiers of Fortune*. This transient behavior which allowed them to escape the war's brutality was of course in marked contrast to the experience of many Africans during the war.[63] A handful like Harry Hay stayed, in true Rough Rider fashion, to dutifully protect the mines and keep them out of the hands of Afrikaners they considered primitive and unfit.[64] Another, Californian and brother of scout Frederick Russell Burnham, Mather Howard Burnham, was left in charge of Rose Deep Mine and the adjoining Glen Deep. Burnham's role was to "keep the mines clear from water," "the machinery in good order and generally to protect the property."[65] Yet, Afrikaners attempted to overtake the mine, and Burnham was nearly hanged as a British spy as a result.[66] Thomas Lane Carter, a mine manager born in New Orleans and educated at Tulane, joined the Rand Rifles during the war and was awarded the Queen's South African medal.[67]

At Kimberley, De Beers General Manager Gardner F. Williams, was said to be "a tower of strength" during the Afrikaner siege of Kimberley.[68] Heaps of tailings, Williams said, "formed natural defensive positions," upon which "strong forts and redoubts" were built with dynamite

[63] Liz Stanley, "Black Labour and the Concentration Camp System of the South African War," *Journal for Contemporary History* 28 (2003): 190–213.
[64] On the gendered and imperialistic dimensions of Theodore Roosevelt and the Rough Riders, see Gail Bederman, *Manliness and Civilization: A Cultural History of Gender and Race in the United States, 1880-1917* (Chicago: University of Chicago Press, 1995), 191–96; Kristin L. Hoganson, *Fighting for American Manhood: How Gender Politics Provoked the Spanish-American and Philippine-American Wars* (New Haven, CT: Yale University Press, 1998), 112–14; Kaplan, *Anarchy of Empire*, 121–45.
[65] 484/56, MS. 484, J. C. Smuts Papers, Brenthurst Library.
[66] "Nearly Hanged on Charge of Spying," *San Francisco Call*, January 17, 1900.
[67] *Anglo-African Who's Who*, 46.
[68] Spence, *Mining Engineers and the American West*, 315. For Williams' account of the siege, see Williams, *Diamond Mines of South Africa*, 605–66.

mines at their base.[69] As the siege prolonged, mechanical engineer George Labram used the De Beers workshops to design and construct a "really formidable" long-range gun named the "Long Cecil," which weighed in at 2,800 pounds.[70] Kimberley was also home to Louis Irving Seymour, a mechanical engineer from New York state who had first arrived in southern Africa in 1890. Before long, Seymour became "the most prominent mechanical engineer in South Africa." When the war began, Seymour soon organized a considerable amount of railway and bridge engineering for military purposes. Seymour was killed in action at Zand River in June 1900, as he was building a bridge. Of the expatriate engineers involved in the war, "none was more missed than Louis Seymour." Remarkably, a portrait painted "in England by a Professor [Hubert] von Herkomer" portrayed Seymour in military, rather than civilian, clothing. After some discussion, the decision was made "by the wishes of his widow and by the fact that [Seymour] died fighting for his country."[71] Here, life imitated fiction, and Seymour was depicted wearing a foreign uniform just as Robert Clay had in *Soldiers of Fortune*. Clay boasted there that he had "worn several uniforms since I was a boy, but never that of my own country." As Amy Kaplan argued, this refusal of US dress makes Clay "more American than the uniformed marine by rendering his nation's qualities universal and self-evident in his own body."[72]

To be sure, many of the threats to life and limb were very real, even if an engineering career never posed the same bodily threat that mine labor did to mine workers. In some cases,

[69] Williams, *Diamond Mines of South Africa*, 608.
[70] Williams, *Diamond Mines of South Africa*, 647.
[71] An international campaign to raise funds in Seymour's honor was conducted after the war, and a technical library in Johannesburg, the Seymour Memorial Library, was named after him. "Major L. I. Seymour," *Engineering and Mining Journal* 76, no. 9 (August 29, 1903): 301–2; J. Ralph Draper, *The Engineer's Contribution: A History of the South African Institution of Mechanical Engineers* (Johannesburg: Kelvin House, 1967), 12–13.
[72] Kaplan, *Anarchy of Empire*, 105–6.

that threat came from mine workers directly. A Seattle civil engineer working in British Columbia in the summer of 1896, Matthew Roderick, was killed by a mining foreman in a duel after Roderick suspected the foreman, Keane, of stealing a gold brick valued at $11,000.[73] Another US mining engineer, Fred Yartell, was killed near Zacatecas, Mexico, "by a Mexican" in an apparent "quarrel over mining work."[74] In 1899 in Durango, Mexico, US engineer Thomas Marrid was "attacked by a band of brigands and murdered," and "his body was robbed of a considerable sum of money and stripped of its clothes."[75] Other dangers came from the environments in which engineers often worked, as in the case of 1904 University of California graduate, Scott I. Beaser. Beaser was reportedly "lost in the mountains in 1911 and was never found."[76] A thorough search for the young engineer near his cabin in Plumas County, in California's Sierra Nevada mountains, was unsuccessful, despite an offer of a $5,000 reward for information leading to his finding.[77] A local newspaper reported that "the case will probably be coupled with the many mysteries attending the profession of mining in the rough places of this state."[78] Indeed, a 1936 Works Progress Administration-funded survey of the careers of University of California mining engineers reveals a surprising number of relatively young deaths.[79]

In memoirs and postings in search of works, it was common for engineers to boast of their bravery in the face of adversity. Engineer Henry W. Darling said he had "gained a great

[73] "Killed in a Duel," *San Jose Mercury News*, October 29, 1896.
[74] "Killed By a Mexican," *San Francisco Call*, June 12, 1897.
[75] "A Mining Engineer in the State of Durango is Murdered," *San Francisco Call*, August 27, 1899.
[76] E. T. H. Bunje, F. J. Schmitz, and D. T. Wainwright, *Careers of University of California Mining Engineers, 1865-1936* (Berkeley: California Cultural Research, 1936), 36.
[77] "Mining Nuggets," *Los Angeles Mining Review* 31, no. 4, 14 October 1911, 17.
[78] "Gives Up Search for Missing Man," *Sacramento Daily Union*, 21 September 1911.
[79] Bunje, Schmitz, and Wainwright, *Careers of University of California Mining Engineers*.

deal of experience while travelling (by canoe, by dogsled, or with the packsack) and prospecting in the Canadian North and while operating various plants in places far remote from the sources of supply; he narrowly escaped several disasters."[80] Hammond characteristically claimed to have been energized and "buoyed up by unending faith and indifference to dangers and privations." These dangers were simply what came with the territory for those in search of gold, "from the days of Jason and the Golden Fleece to this hour," he believed.[81] These threats he took in stride and his white masculinity could be used as a shield even as it made him a target. In Sonora, Hammond claimed, there were "frequent threats were made upon my life." Hammond believed his fidelity and dependability could inspire loyalty among Yaqui, of whom he hired fifteen "and organized them as a bodyguard," supplying them with rifles and teaching them how to shoot.[82] Hammond evinced a certain admiration of the tenacity of the Uto-Aztecan speaking Yaqui of Sonora to resist settler subjugation as he boasted of their loyalty to employers like himself: "As a matter of fact, until within recent years no military expedition has been able to expel the Indians from their mountain retreats. The loyalty of the Yaqui to their employers, however, is well recognized by all Americans in Mexico and, indeed, even by their hereditary enemies, the Mexicans."[83] Similarly, it was a point of pride for the notoriously anti-union Hammond that during the labor battles in Coeur d'Alene, Idaho, Pinkerton detective Charles A. Siringo

[80] *Careers of University of California Mining Engineers*, 46–47.
[81] Hammond, *Autobiography*, 1:97.
[82] Hammond, *Autobiography*, 1:116–17.
[83] Hammond, *Autobiography*, 1:140. The reality was naturally far more nuanced and complex than what Hammond described. Writing of Hammond and other South African connections to Sonora and the Yaqui, Andrew Offenburger concludes that they "rebelled *and* cooperated, a paradoxical strategy that frustrated state administrators at every turn." Offenburger, *Frontiers in the Gilded Age*, 147–86. Quotation on 181.

> steadily relayed to us plots for beating up and killing scab miners whenever they should be brought in from other places for resumption of operations. He reported in advance the plans made for a "bloody revolution" on the Fourth of July, when, as a matter of fact, the American flag was riddled with bullets, trampled, and spat upon. He cut from the minutes one page of particular interest to me. It not only recorded the union's decision to have its members creep up in the night on two of the mines and flood them by pulling the pumps, but also on this same page was written the decision of the unionists to "do away with" [fellow mining engineer Victor] Clement and me. This page Siringo mailed to our lawyers.[84]

Tellingly, Hammond evinces no fear over being murdered by workers, or details any plans to avoid such an outcome, simply passing the information along to their lawyers. Rather, he included it in his autobiography to show his bravery in the face of death, as well as his implicit patriotism.

Dominating animals could likewise function as a place for the performance of strenuous masculinity.[85] Paul Selby, a 1901 graduate of the University of California had worked at a number of mines on the Rand, including the Durban Roodeport Deep, the Robinson and the Ferreira Deep. Selby was a keen sportsman, who showed collies and served as President of the Witwatersrand Kennel Club, and also took an interest in wildlife photography.[86] Selby and his

[84] Hammond, *Autobiography*, 1:192. On Siringo's role in suppressing the Coeur d'Alene strikers, see Howard R. Lamar, *Charlie Siringo's West: An Interpretive Biography* (Albuquerque: University of New Mexico Press, 2005), 173–88.

[85] On the intersection of hunting, empire, and masculinity, see John M. MacKenzie, *The Empire of Nature: Hunting, Conservation, and British Imperialism* (Manchester: Manchester University Press, 1988); William Beinart, "Empire, Hunting and Ecological Change in Southern and Central Africa," *Past and Present* 128, no. 1 (August 1990): 162–86; Tina Loo, "Of Moose and Men: Hunting for Masculinities in British Columbia, 1880-1939," *Western Historical Quarterly* 32, no. 3 (Autumn 2001): 296–319; Greg Gillespie, *Hunting for Empire: Narratives of Sport in Rupert's Land, 1840-70* (Vancouver: UBC Press, 2007); Karen R. Jones, *Epiphany in the Wilderness: Hunting, Nature, and Performance in the Nineteenth-Century American West* (Boulder: University Press of Colorado, 2015); Angela Thompsell, *Hunting Africa: British Sport, African Knowledge and the Nature of Empire* (Basingstoke, UK: Palgrave Macmillan, 2015); Antoinette Burton and Renisa Mawani, eds., *Animalia: An Anti-Imperial Bestiary for Our Times* (Durham, NC: Duke University Press, 2020).

[86] "S. A. Kennel Union," *Eastern Province Herald* 5 April 1920, 8; "P.E. Kennel Club Annual Show," *Eastern Province Herald*, 24 March 1922, 7. Selby's photographs are stored in the Selby Collection 590.72, MuseumAfrica, Johannesburg.

wife received British archaeologist Henry Balfour in his 1929 visit to South Africa as part of his tour as President of the British Association for the Advancement of Science's Anthropology section.[87] Selby served as representative of the Wildlife Protection Society of South Africa on the National parks Board of Trustees. Selby also played a role in the establishment of the Sabi Game Reserve, which became Kruger National Park in 1926.[88]

The tumultuous career of William J. Loring illustrates the toll the work of a mining could take and the necessity if keeping up with appearances. Born in San Mateo County, California, Loring worked under Hoover in Australia, before a turn in Burma, and then in 1908, the Gold Coast of West Africa. There he caught malaria, a disease Loring believed he never "fully recovered from." Loring next moved to the Porcupine goldfield in northeastern Ontario, in 1910. Crossing a frozen lake at forty below zero, his team froze in place upon sighting wolves. Closer inspection revealed that it was merely an "optical illusion" produced by "a broken-down sleigh loaded with goods […] which appeared to move about in the star-lit and snow-clad whiteness of this northern night."[89] A failed investment in a California mine in the late 1910s was financially devastating to him. Being accustomed to a life of luxury, Loring borrowed

[87] On an earlier visit to southern Africa in 1905, Balfour experienced a taste of engineers' capacity for destruction. While in Macheke, Mashonaland he rushed off the train to view a small kopje with a "Bushman rock shelter with paintings, elands, sable etc. + men represented with much skill" but lamented that the "rock had been broken in two by an engineer who wished to remove the paintings for a museum. The fracture extends right across the paintings, the lower portion alone remaining in situ." Henry Balfour, "South Africa July – December 1905" (1905), Pitt Rivers Museum, https://www.prm.ox.ac.uk/south-africa-july-december-1905; Henry Balfour, "South and East Africa. 1929. Tour as President of the Anthropology Section of the B. A. A. S. (British Association for the Advancement of Science)" (1929), Pitt Rivers Museum, https://www.prm.ox.ac.uk/south-and-east-africa-1929-tour-president-anthropology-section-baas-british-association-advancement.

[88] Jane Carruthers, *The Kruger National Park: A Social and Political History* (Pietermaritzburg: University of Natal Press, 1995), 68–69. Also see the excellent Jacob S. T. Dlamini, *Safari Nation: A Social History of the Kruger National Park* (Athens: Ohio University Press, 2020).

[89] Rickard, *Interviews with Mining Engineers*, 275–82.

heavily, and after his investments failed, he died penniless in Nevada at age 83.[90] In spite of these failings, Loring was still held up as a great engineer and included as one of the few to make it into T. A. Rickard's interviews in the *Engineering and Mining Journal*. Rickard's editorial commentary lauded Loring for early in his career acquiring the "essential virility of the men that directed technical operations." Rickard also gently noted Loring's "slight" case of malaria, and offered it as a lesson to young engineers not to "sell their birthright—good health—for a mess of pottage—an increase of pay."[91] The enervating tropical climate of the Gold Coast of West Africa, the source of the malaria, worked to mend Loring's whiteness and masculinity even in the face of failure.

Women Shoulder the Load

Behind these outward expressions of masculinity were the wives and families of mining engineers, who frequently ignored for their contributions to social reproduction and domesticity. It was more common only for the most elite mining engineers to travel with their family, but when the family traveled, they often traversed many miles. As Hammond described his move to South Africa: "In the autumn of 1893 my family—consisting of myself and wife, my sister Betty, and my two sons Harris and Jack—came to Africa."[92] For Hoover, travel for him necessarily meant travel for his wife, Lou Henry Hoover, as well: "Our problems being all over the world, I was involved in a vast amount of travel—in fact, after joining this partnership, I

[90] Ronald H. Limbaugh, *Tungsten in Peace and War, 1918-1946* (Reno: University of Nevada Press, 2010); Ron Limbaugh, "Pitting the Comstock: W. J. Loring and the Arizona Comstock Company," *Mining History Journal* 22 (2015), 16.
[91] Rickard, *Interviews with Mining Engineers*, 289, 291.
[92] Hammond, *Autobiography*, 1:205.

circled the globe five times. Mrs. Hoover went on most of these journeys, and when the babies came she brought them along in a basket."[93]

The wives of mining engineers frequently involved managing the household, making them in charge of domesticity.[94] It was not uncommon for the class on the Rand to have anywhere from four to six servants. Sidney Jennings' wife played a role in the Johannesburg branch of the British Women's Emigration Association, which aimed to relieve Britain of a "surplus" of young women by bringing them to the Rand where they could replace black "houseboys."[95]

Publicly, entertaining and socializing were important roles for wives to fulfill. In 1902, after the end of the South African War, Virginia Webb, wife of mining engineer Harry Howard Webb and other wives of prominent American men on the Rand formed the Martha Washington Club, holding monthly receptions and an annual ball.[96] In August 1904, the Martha Washington Society, including Elizabeth Catlin, wife of Robert Catlin, entertained visiting American naval officers at the home of Lionel Curtis in Bertramstown, a suburb of Johannesburg. Elizabeth Catlin giving the visitors "a glimpse of colonial outdoor amusement" at a "distinctly Dutch" house with "rugged kopje" in the background and an "alluring vista of veld

[93] Hoover, *Years of Adventure*, 75.
[94] Historians have demonstrated that the household is not simply private but deeply connected to empire and white supremacy. See Kaplan, *Anarchy of Empire*, 23–50; Thavolia Glymph, *Out of the House of Bondage: The Transformation of the Plantation Household* (Cambridge: Cambridge University Press, 2008); Roediger and Esch, *Production of Difference*, 108–14.
[95] Van Onselen, *New Nineveh*, 207.
[96] "Society Echoes," *South Africa*, 23 May 1908, 529; "Harry H. Webb Dies; Mining Engineer, 85; Once Was Manager of Rhodes Properties in South Africa," *New York Times*, 4 June 1939; Stephen Tuffnell, "Business in the Borderlands: American Trade in the South African Marketplace, 1871–1902," in *Imagining Britain's Economic Future, c. 1800-1975*, ed. David Thackeray, Andrew Thompson, and Richard Toye (Basingstoke, UK: Palgrave Macmillan, 2018), 43–68.

stretching away into illimitable distance."[97] On another occasion, Club President, wife of US mining engineer Paul Selby was said to "deserve considerable praise" for organizing the club's 1912 Ball at Johannesburg's Carlton Hotel. The "lavishly decorated" hall was filled with chrysanthemums and carnations, while the tables were covered with "English and American flags." China dolls made to appear like Martha Washington were handed out to each lady in attendance. The guest list read like a who's who of elite Johannesburg, with the wife of the mayor, as well as Lady Farrar (wife of Randlord George Farrar), several daughters of George Albu, William Honnold and his wife, Julius Jeppe, and so on.[98]

Philanthropy and charity were another important role for engineers' wives. Henry Perkins' wife helped finance the construction of a new school in South Africa, and ensured it was modeled along US lines of education.[99] During the Jameson Raid, Natalie Hays Hammond and her sister-in-law Mary-Elizabeth, as well as Mrs. Victor Clement, with flowers and books to distribute, "paid daily visits to the women and children who were house at the Wanderers' Club, which, together with Tattersalls, had been converted into a refugee centre."[100] During the South African War, Mary L. Jennings, wife of Hennen Jennings, donated £500 to the "American Hospital Ship Fund," funded by another US woman, Jennie Blow, whose husband A. A. Blow, formerly of Leadville, Colorado, managed the Sheba Gold Mine syndicate.[101] Led by the US-born

[97] "The American Visit," *Rand Daily Mail*, 29 August 1904, 8.
[98] "Martha Washington Ball" *Rand Daily Mail*, 13 April 1912, 10.
[99] De Waal, "The Part Played by the Americans," 196.
[100] De Waal, "The Part Played by the Americans," 194; Harris, *Woman's Part in a Revolution*, 35.
[101] *Engineering and Mining Journal*, 66, 22 October 1898, 494.

Jennie (Lady Randolph) Churchill, the fund provided the means to convert and equip the vessel for use in treating wounded soldiers, arriving in Durban in 1900.[102]

Beyond mining engineers' wives' role in social reproduction and maintaining the domestic sphere, some prominent mining engineers relied quite heavily on their wives for many important functions.[103] Mary Hallock Foote became far better known than her husband, who was not the successful engineer of fiction. Foote gave up a promising career on the east coast to join her husband and became well known for her widely published illustrations and writings on western mining life (Image 2).[104]

Herbert Hoover relied on his wife Lou to assist with fieldwork, in addition to the childrearing responsibilities discussed above. Hoover recalled meeting "Miss Lou Henry" in Stanford's geology laboratories, where she was "determined to pursue and teach that subject as a livelihood." He was evidently taken by the fact that Lou "was the daughter of a hunting-fishing country banker at Monterey who had no sons and therefore had raised his daughter in the out-of-door life of a boy," making her the ideal field companion in his view.[105] Incredibly, Lou found the time and energy during "night hours, weekends, and holidays, in all extending over a period of about five years" to translate Agricola's famed mining manual, *De Re Metallica* from Latin into English.[106] Herbert Hoover admitted that his own "study of Latin had never gone beyond some elementary early schooling and a few intermittent attempts to penetrate

[102] "The War," *Times* (London), November 11, 1899, 12; Stephen Tuffnell, *Made in Britain: Nation and Emigration in Nineteenth-Century America* (Oakland: University of California Press, 2020), 171.
[103] This was a pattern not confined to US and British mining engineers. For instance, see Barbara Mohr, "Wives and Daughters of Early Berlin Geoscientists and Their Work behind the Scenes," *Earth Sciences History* 29, no. 2 (2010): 291–310.
[104] Oldenziel, *Making Technology Masculine*, 131–34.
[105] Hoover, *Years of Adventure*, 23.
[106] Georgius Agricola, *De Re Metallica*, trans. Hoover, Herbert Clark and Lou Henry Hoover (London, 1912), *iii.*

further," but "Mrs. Hoover was a good Latinist after she brushed up a little." Additionally, "Mrs. Hoover's ability to read German and some French helped greatly." Hoover apparently was unable to fully give his wife credit: despite her far superior language skills, he wrote that "we" were able to work out the formerly untranslatable Agricola.[107]

During the Jameson Raid, in which US mining engineers Hammond, Joseph Curtis, Victor Clement, Thomas Mein, and Charles Butters were imprisoned, Natalie Harris Hammond led a campaign to see to their release. Hammond even met with Paul Kruger personally to see to her husband's release, even as other mining engineers on the Rand, Hennen Jennings and Henry Perkins, did the same and failed to effect their release.[108]

A casual oral history conducted in 1959 at the home of W. W. Mein in San Francisco, provides a sense of the professionalism mixed with bravado that characterized so many mining engineers, but also the importance engineers placed on their choice of partner. The interviewer was Mein's "mining friend of 43 years," mining engineer Henry C. Carlisle. The pair were introduced in 1916 at the Mandy copper mine in Manitoba and were neighbors for many years in San Francisco. Carlisle reflected on Mein's affiliation with the famed Robinson gold mine on the Rand, the De Beers diamond mine, and the Bank of America, of which Mein had been a director since 1944. But above all, Carlisle focused on Mein's wife: "Now let's sum up this up. From what you have told me, Will, you have been identified with the biggest gold mine in the world, the biggest nickel mine in the world, and you have been very much identified with the biggest bank in the world. Then, to top off all that, you married the daughter of General

[107] Hoover, *Years of Adventure*, 117–19.
[108] Natalie Harris Hammond, *A Woman's Role*, 7, 69.

Manager of biggest diamond mine in the world, and that, as you have also told me, was your greatest achievement. So, all in all, Will, you have done all right."[109] It was a rare acknowledgement of the importance of women—their labor, knowledge, and connections—that supported the performances of masculinity.

The masculine independent streak lived on, forming, for instance, Hoover's 1928 campaign slogan of "rugged individualism," a philosophy that quickly ran aground in the Great Depression. As mining became increasingly corporatized and bureaucratized into the twentieth century, its leaders became increasingly removed from the edge of empire and from the stuff of fiction. Thayer Lindsley, by 1951 the "undisputed No. 1 figure in Canadian mining, who carved out Canada's biggest mineral empire and then went on to create another international empire just as great," is instructive in this regard. The aggressively masculine language and outside expectations remained: a journalist described Lindsley's parent company, Ventures Ltd., as the "corporate daddy of Lindsley's globe-girdling mining empire," and held to be "Canada's most aggressive mine exploration and holding company." Yet Lindsley himself was described by a friend as "girlishly shy." Not one to hunt, boast, or "handle" men working at his mines, Lindsley was "a hard-working, simple-living, deep-thinking introvert who sleeps little, talks little, eats little, drinks less and doesn't play at all."[110]

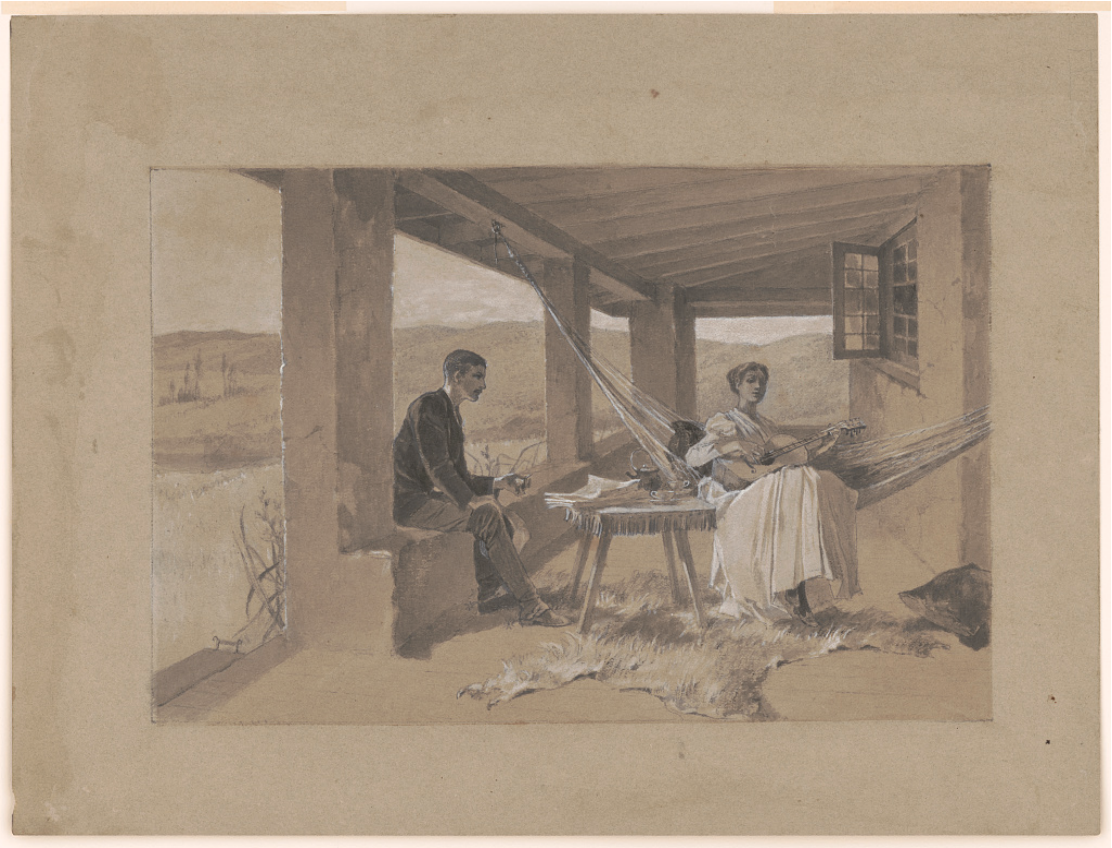
The example of Lindsley demonstrates that the white masculinity exemplified by Hamilton Smith, or even the fictional Robert Clay, had not disappeared. Significantly, it continued to underwrite the toxic exploitation of the planet and the people living on it, just in

[109] Reminiscences of William Wallace Mein, 18.
[110] Bodsworth, "Unknown Giant of Canadian Mining."

different form. How that played out for the environment and for workers is the subject of the final three chapters.

Image

Image 2: Mary Hallock Foote Illustration



Mary Hallock Foote, *A Pretty Girl in the West*, 1889, Prints and Photographs Division, Library of Congress, https://www.loc.gov/pictures/item/2010715869/.

Chapter 3. Men Who Love a Fight with Nature: Disassembling the Earth in California and South Africa, 1870-1910

> It's the dust in the air that makes the Highveld sunsets so spectacular, the fine yellow mineral deposits kicked up from the mine dumps, the carbon-dioxide choke of the traffic. Who says bad things can't be beautiful?
>
> —Lauren Beukes, *Zoo City*

> They come and go, like ants and termites, carrying on their heads or on their backs the weight of the burden, with body and feet in the mud. And, at the surface, blast furnaces and smokestacks, and then tumuli of which we know not if they are pyramids, mausoleums, or one inside the other. Something, manifestly, has been extracted from the ground and crushed here, in the guts of the machine.
>
> —Achille Mbembe, *Necropolitics*

Herbert Hoover held that a requisite quality for members of his "great profession" of engineering was that they were "men who love a fight with nature."[1] Hoover's comment reveals how masculinity—specifically an imperialist, white version of it—was a constituent element of how mining engineers approached the natural world. Similarly, John Hays Hammond believed that engineers exploiting the earth underpinned all modern civilization, to great benefit. Hammond declared, "Our machine civilization has been wrought by the engineer, who contrives its apparatus, utilizes and harnesses the physical and chemical forces of nature, and exploits the resources of the earth. All that he designs and invents and exploits redounds in the end to the public benefit."[2] This conception of engineers as standing between humans and the non-human world, and making the latter knowable and manipulable to the former, is a durable one. Historian of engineering Antoine Picon has argued that a defining feature of engineering is "its belief in a natural order that should be a permanent source of inspiration for

[1] Hoover, *Years of Adventure*, 132.
[2] Hammond, *Autobiography*, 2:735.

men and their organizations." Moreover, Picon argues, "engineers have generally seen themselves as mediators between nature and man" who take as their task making "nature exploitable."[3]

However, because engineers have long been located in this "boundary object" position—and remain so—environmental and other historians, as well as social theorists more broadly, have generally neglected the role of engineers in shaping the non-human world.[4] Recently, in the context of an escalating climate crisis and other ecological concerns facing the planet—a conjuncture sometimes referred to as the Anthropocene—the function of capitalism in separating humans from non-human nature has rightly concerned many authors.[5] While not rejecting that argument, this chapter joins a more recent group of scholars who have shown that the ecological problems facing this planet are larger in nature than political economy. As Julie Livingston convincingly argues, "while self-devouring growth is the central dynamic of

[3] Picon, "Engineers and Engineering History," 421–36.

[4] Some exceptions not mentioned elsewhere in this chapter include Robert Vitalis, *America's Kingdom: Mythmaking on the Saudi Oil Frontier* (Stanford: Stanford University Press, 2007); Gregory T. Cushman, *Guano and the Opening of the Pacific World: A Global Ecological History* (New York: Cambridge University Press, 2013), 145–65; Aaron Stephen Moore, "'The Yalu River Era of Developing Asia': Japanese Expertise, Colonial Power, and the Construction of Sup'ung Dam," *Journal of Asian Studies* 72, no. 1 (February 2013): 115–39; Donald C. Jackson, "The Engineer as Lobbyist: John R. Freeman and the Hetch Hetchy Dam (1910–13)," *Environmental History* 21, no. 2 (April 2016): 288–314; Mikael D. Wolfe, *Watering the Revolution: An Environmental and Technological History of Agrarian Reform in Mexico* (Durham, NC: Duke University Press, 2017); Jennifer L. Derr, *The Lived Nile: Environment, Disease, and Material Colonial Economy in Egypt* (Stanford, CA: Stanford University Press, 2019); Daniel Macfarlane, *Fixing Niagara Falls: Environment, Energy, and Engineers at the World's Most Famous Waterfall* (Vancouver: UBC Press, 2020); Roderick I. Wilson, *Turbulent Streams: An Environmental History of Japan's Rivers, 1600-1930* (Leiden: Brill, 2021); Owain Lawson, "A National Vocation: Engineering Nature and State in Lebanon's Merchant Republic," *Comparative Studies of South Asia, Africa and the Middle East* 41, no. 1 (May 2021): 71–87.

[5] John Bellamy Foster, *Marx's Ecology: Materialism and Nature* (New York: Monthly Review Press, 2000); Jason W. Moore, *Capitalism in the Web of Life: Ecology and the Accumulation of Capital* (London: Verso, 2015); Anna Lowenhaupt Tsing, *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* (Princeton, NJ: Princeton University Press, 2015); Jason W. Moore, ed., *Anthropocene or Capitalocene? Nature, History, and the Crisis of Capitalism* (Oakland, CA: PM Press, 2016); Andreas Malm, *Fossil Capital: The Rise of Steam Power and the Roots of Global Warming* (London: Verso, 2016); Hannah Appel, *The Licit Life of Capitalism: US Oil in Equatorial Guinea* (Durham, NC: Duke University Press, 2019). Intriguingly, Jack Goody has argued that the search for metals itself fueled the rise of capitalism. See Jack Goody, *Metals, Culture and Capitalism: An Essay on the Origins of the Modern World* (Cambridge: Cambridge University Press, 2012).

capitalism, it cannot be reduced to it. The former Soviet Union undertook its own version of self-devouring growth. So did Maoist China."[6]

Methodologically this chapter uses mining engineers to bring together environmental history and the history of capitalism with histories of gender, race, and empire. As chapter 2 demonstrated, masculinity was essential for engineers to dominate and subjugate people and the planet, and accordingly this chapter follows Traci Brynn Voyles' wonderfully creative understanding of "toxic masculinity," wherein the toxicity is literal rather than figurative.[7] Voyles argues that "robust men's bodies engaging in environmental vandalism has been a constitutive feature of white settler manliness."[8] Environmental history has long been distant

[6] Julie Livingston, *Self-Devouring Growth: A Planetary Parable as Told from Southern Africa* (Durham, NC: Duke University Press, 2019), 6. Other key examples include Laura Bear et al., "Gens: A Feminist Manifesto for the Study of Capitalism," *Fieldsights*, March 30, 2015; Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham, NC: Duke University Press, 2016), 30–57; Bathsheba Demuth, *Floating Coast: An Environmental History of the Bering Strait* (New York: W. W. Norton, 2019); Achille Mbembe, *Necropolitics*, trans. Steven Corcoran (Durham, NC: Duke University Press, 2019); Dipesh Chakrabarty, *The Climate of History in a Planetary Age* (Chicago: University of Chicago Press, 2021), 49–67.

[7] Traci Brynn Voyles, "Toxic Masculinity: California's Salton Sea and the Environmental Consequences of Manliness," *Environmental History* 26, no. 1 (January 2021): 127–41. On masculinity and the environment, also see Merchant, *Death of Nature*; R. W. Connell, 'A Whole New World: Remaking Masculinity in the Context of the Environmental Movement,' *Gender & Society* 4, no. 4 (1990): 454; Cara Daggett, "Petro-Masculinity: Fossil Fuels and Authoritarian Desire," *Millennium: Journal of International Studies* 47, no. 1 (2018): 25–44; E Cram, *Violent Inheritance: Sexuality, Land, and Energy in Making the North American West* (Oakland: University of California Press, 2022).

[8] Voyles, "Toxic Masculinity," 129. Significant works on the relationship between environment and empire include Richard H. Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600-1860* (Cambridge: Cambridge University Press, 1995); Drayton, *Nature's Government*; Peder Anker, *Imperial Ecology: Environmental Order in the British Empire, 1895-1945* (Cambridge, MA: Harvard University Press, 2001); Tilley, *Africa as a Living Laboratory*; Ross, *Ecology and Empire*; Robert M. Rouphail, "Cyclonic Ecology: Sugar, Cyclone Science, and the Limits of Empire in Mauritius and the Indian Ocean World, 1870s–1930s," *Isis* 110, no. 1 (March 2019): 48–67; Ulrike Kirchberger and Brett M. Bennett, eds., *Environments of Empire: Networks and Agents of Ecological Change* (Chapel Hill: University of North Carolina Press, 2020).

from the history of race, as a number of critics have noted.[9] The history of southern Africa's mineral revolution, for instance, is not conventionally seen through the prism of environment.[10]

These historiographical aporia may have something to do with what Rob Nixon has called "slow violence," wherein environmental harm, especially to poor and marginalized people, often occurs insidiously, out of sight and out of time, as it were. Nixon argues that "from a narrative perspective, such invisible, mutagenic theater is slow paced and open ended, eluding the tidy closure, the containment, imposed by the visual orthodoxies of victory and defeat."[11] These forms of violence often leave no archival trace for the historian.

Writing of violence both spectacular and slow in the wake of the First World War and the 1918 influenza pandemic, W. E. B. Du Bois grappled with similar issues in his 1920 *Darkwater: Voices from Within the Veil*, where he described these catastrophes as "a wide vision of world-sacrifice, a fierce gleam of world-hate." Du Bois argued that facing the

[9] For an overview of the relationship between the two, see Carolyn Merchant, "Shades of Darkness: Race and Environmental History," *Environmental History* 8 (July 2003): 380–94. Some significant exceptions include Donald S. Moore, Jake Kosek, and Anand Pandian, eds., *Race, Nature, and the Politics of Difference* (Durham, NC: Duke University Press, 2003); Carl A. Zimring, *Clean and White: A History of Environmental Racism in the United States* (New York: New York University Press, 2015); Leilani Nishime and Kim D. Hester Williams, eds., *Racial Ecologies* (Seattle: University of Washington Press, 2018); Laura Pulido, "Flint, Environmental Racism, and Racial Capitalism," *Capitalism Nature Socialism* 27, no. 3 (2016): 1–16.

[10] Exceptions include Jacob A. Tropp, *Natures of Colonial Change: Environmental Relations in the Making of the Transkei* (Athens: Ohio University Press, 2006); William Kelleher Storey, "Cecil Rhodes and the Making of a Sociotechnical Imaginary for South Africa," in *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, ed. Sheila Jasanoff and Sang-Hyun Kim (Chicago: University of Chicago Press, 2015), 34–55; Meredith McKittrick, "Talking about the Weather: Settler Vernaculars and Climate Anxieties in Early Twentieth-Century South Africa," *Environmental History* 23, no. 1 (January 2018): 3–27; William Beinart and Peter Coates, *Environment and History: The Taming of Nature in the USA and South Africa* (London: Routledge, 1995); Jacklyn Cock, *Writing the Ancestral River: A Biography of the Kowie* (Johannesburg: Wits University Press, 2018); Jacob S. T. Dlamini, *Safari Nation: A Social History of the Kruger National Park* (Athens: Ohio University Press, 2020); Marc Epprecht, *Welcome to Greater Edendale: Histories of Environment, Health, and Gender in an African City* (Montreal: McGill-Queen's University Press, 2016); Nancy J. Jacobs, *Environment, Power, and Injustice: A South African History* (Cambridge: Cambridge University Press, 2003); Simon Pooley, "Fire, Smoke, and Expertise in South Africa's Grasslands," *Environmental History* 23, no. 1 (January 2018): 28–55.

[11] Nixon, *Slow Violence*, 6.

contradiction of life and death required a "subtle and involved" explanation: "No pert and easy word of encouragement, no merely dark despair, can lay hold of the roots of these things. And first and before all, we cannot forget that this world is beautiful."[12] While Du Bois is not known as an environmental thinker, his concept of white dominion—where the promise of whiteness promises possession of the earth—is indispensable to understanding mining engineers' view of the non-human world.[13] Writing from an Indigenous studies perspective, Aileen Moreton-Robinson argues that "patriarchal whiteness can be deployed simultaneously or separately as status, identity, and property. As a form of property, patriarchal whiteness is a valuable possession warranting protection."[14]

To demonstrate how white dominion functioned to underwrite environmental harms empirically, this chapter begins with gold and mercury extraction sites of California in the 1870s and 1880s. It was there that US mining engineers developed beliefs and practices about racial capitalism and humans' relationship to the nonhuman world that were instrumental in setting a course toward the spatially and racially differential exposure to environmental harm that continues today. This chapter considers the environmental elements of mining and mining engineers' role in that in both California and South Africa. It first surveys engineers' role in hydraulic placer mining in California and how their training and ideas informed their view of the environment. I then show how governmental regulation and the end of hydraulic mining were key push factors that led to mining engineers seeking positions abroad, especially in colonial

[12] W. E. B. Du Bois, *Darkwater: Voices from Within the Veil* (New York: Harcourt, Brace, and Howe, 1920), 225.
[13] On Du Bois and white dominion, see Ella Myers, "Beyond the Psychological Wage: Du Bois on White Dominion," *Political Theory* 47, no. 1 (2019): 6–31.
[14] Moreton-Robinson, *White Possessive*, 67.

spaces free from such oversight. Then the story picks up on the Rand, where I show how US engineers were instrumental in facilitating and pushing for ever-increasing scale of mining and greater volume of mine waste. The chapter then surveys contemporary issues and struggles surrounding environmental racism and the legacies of extraction in Johannesburg. Finally, the chapter demonstrates that this environmental problem is a major reason why Johannesburg became racially segregated, with exposure to environmental harms a key determinant of where people live.

Mining Engineers and the Environment

Historians of mining engineers and mining more broadly consistently point to a tension, or contradiction, inherent to mineral extraction whereby extractivists had to know the earth to extract from it, and accordingly, extracting required knowledge of the earth. Hoover's biography opens with an innocent, naïve sketch of Hoover as a boy playing in the woods by the Burlington railroad track, full of pigeon, rabbits, and prairie chickens. There was even a "real live American Indian boy" to instruct him in the use of a bow and arrow. Hoover recalled that these woods were "an inspiring place" and waxed lyrical about their geologic qualities: "It was ballasted with glacial gravels where, by hard search, you discovered gems of agate and fossil coral which could, with infinite backaches, be polished on the grindstone. Their fine points came out wonderfully when wet, and you had to lick them with your tongue before each exhibit." Tragically, however, Hoover lamented that modernity and engineering specifically had likely consigned his childhood experience to the past: "I suppose that engineering has long since destroyed this inspiration to young geologists by mass-production of crushed rock."[15]

[15] Hoover, *Years of Adventure*, 2–3.

Marveling at the beauty of the natural world was not unheard of even for the most manly of engineers. On a working visit to Oaxaca, Mexico, John Hays Hammond admired the Arbor del Tule, "a gigantic cypress, measuring about a hundred and fifty feet in height, a hundred in girth, and with a colossal branch spread of a hundred and forty feet. It is supposed to have been standing a thousand years before Columbus discovered America, and to have sheltered Cortez and his soldiers when they invaded Mexico."[16] Certainly engineers could appreciate the natural world as it was, without intervention or destruction.

Historians of mining offer several useful ways of considering this tension.[17] Kathryn Morse has shown how only in the process of "disassembling" the earth—the "work of taking nature apart"—did "gold miners came to know nature so well."[18] Andrew Isenberg describes the ecological harm wrought by hydraulic mining in California as arising not from indifference to the nonhuman world but as the result of "imposing the burden of industrialization on the environment." This was "part of an effort to "impose order" and "make the extraction of resources regular and predictable."[19] Finally, Timothy LeCain has shown how this tension was a dynamic that changed over time: although the first generation of mining engineers could appreciate the beauty of the natural world, they "faced a dilemma: the more they succeeded in taming nature, the more they denied themselves the rugged wild places essential to the creation of their personal and professional ideals." Further, "as the challenges of engineering

[16] Hammond, *Autobiography*, 1:141. While Hammond claimed that "The great naturalist and traveler, [Alexander] von Humboldt, had carved his name on the trunk and it could still be seen," there is no evidence that Humboldt reached Oaxaca during his 1803 visit to Mexico, although he did write about the famed tree.
[17] In the case of fossil fuels, see David Bond, *Negative Ecologies: Fossil Fuels and the Discovery of the Environment* (Oakland: University of California Press, 2022).
[18] Morse, *Nature of Gold*, 93.
[19] Andrew C. Isenberg, *Mining California: An Ecological History* (New York: Hill and Wang, 2005), 51.

the environmental and technological interactions […] became more complex, engineers and their corporate masters would increasingly" turn to "the modern dichotomous view that split the technological from the environmental, the human from the wilderness, and even the male from the female."[20] In short, the tension was technopolitical in nature: a process of human and non-human "in which the intentional or the human is always somewhat overrun by the unintended."[21] Kent Curtis has shown how the scale was let to get so large: by "confronting proximate challenges only," it never became obvious at any single point "how deep and destructive the mining relationship would become in the United States."[22] Finally, Bathsheba Demuth has usefully articulated the central challenge of mining, which is "undoing stasis, in altering the entropic results of deep time."[23] Importantly, undoing that stasis is what is responsible for the vast majority of the ecological damage mining brings in the form of acid mine drainage, as well as dust and tailings—refuse from the earth that is extracted. Environmental historians and historians of mining have not considered tailings generally, which is a key contribution of this chapter.[24]

California

The 1884 Sawyer court decision that banned hydraulic gold mining went against everything mining engineers had been taught to believe. Engineers commonly revered the early

[20] LeCain, *Mass Destruction*, 55–61.
[21] Mitchell, *Rule of Experts*, 43. On this relationship also see Sara B. Pritchard and Thomas Zeller, "The Nature of Industrialization," in *The Illusory Boundary: Environment and Technology in History*, ed. Martin Reuss and Stephen H. Cutcliffe (Charlottesville: University of Virginia Press, 2010), 69–100; Sara B. Pritchard, *Confluence: The Nature of Technology and the Remaking of the Rhône* (Cambridge, MA: Harvard University Press, 2011).
[22] Curtis, *Gambling on Ore*, 9.
[23] Bathsheba Demuth, *Floating Coast: An Environmental History of the Bering Strait* (New York: W. W. Norton, 2019), 201.
[24] One recent exception is Sebastián Ureta and Patricio Flores, *Worlds of Gray and Green: Mineral Extraction as Ecological Practice* (Oakland: University of California Press, 2022).

modern metallurgist Georgius Agricola, whose 1556 treatise on mining, *De re metallica*, justified mining's environmental harms by saying its benefits outweighed them.[25] Mining engineers believed they were the key players in the drama of humans' triumph over nature. Without mining and metallurgy, Hennen Jennings said, humans would be taken "back to savagery."[26] Beginning in the 1860s and especially in the 1870s, no one was more central to that effort that mining engineers. Trained in both applied geology and modern cost accounting methods, mining engineers had one overall aim: reducing the working costs per ton of ore mined. While this naturally had a geologic dimension, as importantly it had a labor dimension as well.[27] Hydraulic mining did not produce more gold than placer mining, but it did reduce labor costs.[28]

Working on the North Bloomfield and New Almaden mines was also Jennings' practical introduction to mining: it was an education in the commodification of water, the use of Chinese labor (frequently employed to do the work of dam building), and in failure, given how frequently dams collapsed.[29] This dissertation will return to Chinese labor in the subsequent chapter, but above all, Jennings learned the most important lesson to be drawn from hydraulic

[25] Georgius Agricola, *De Re Metallica*, trans. Hoover, Herbert Clark and Lou Henry Hoover (London: The Mining Magazine, 1912 [1556]). Recently, Phillip Usher has provocatively read Agricola to counter Bruno Latour's argument that the Anthropocene is without precedent. Phillip John Usher, *Exterranean: Extraction in the Humanist Anthropocene*, (New York: Fordham University Press, 2019), 80–97. On the significance of Agricola to prominent US mining engineer, see Jeffrey Bartos, "The Accumulated Knowledge of a Thousand Generations: U.S. Mining Engineers as Public Intellectuals, 1885–1920," *Technology and Culture* 62, no. 4 (October 2021), 1177–79.
[26] Hennen Jennings, *Mining as a Profession, Including First Stages of Metallurgy* (Mining and Scientific Press, 1914), 1.
[27] For a social history of these mid-nineteenth-century changes in accounting, see Michael Zakim, *Accounting for Capitalism: The World the Clerk Made* (Chicago: University of Chicago Press, 2018).
[28] Andrew C. Isenberg, "The Real Wealth of the World: Hydraulic Mining and the Environment in the Circum-Pacific Goldfields," in *A Global History of Gold Rushes* (Oakland: University of California Press, 2018), 216.
[29] Isenberg, *Mining California*, 28–29.

mining: its advantage as a method of extraction was not its ability to extract more gold, but rather its ability to reduce labor.[30]

Jennings next worked at the New Almaden mercury (quicksilver) mine, where he learned to survey from Ross E. Browne. Jennings credited Browne as the mentor who gave him his "first step in the profession" and later "to come into engineering prominence," as a result of "the close-connecting surveys that I made in the [New Almaden] mine under difficult conditions."[31] The New Almaden also introduced Jennings to two noted geologists, Samuel B. Christy and George F. Becker. He also met Charles Butters, who immediately went to the New Almaden upon graduating from the University of California in 1879, and "who acted as chemist for a short time while I was surveyor and engineer."[32]

Hydraulic mining involved shooting large hoses of water at the sides of rivers. It was significantly more capital intensive than the placer mining it replaced, hardening class lines in the process and sparking race- and ethnic-based violence.[33] Mining engineers like Rossiter Raymond and others relied on Chinese laborers working for wages to do much of the difficult and dangerous work.[34] Blasting away riverbanks caused enormous amounts of sediment and toxins to wash downstream, producing widespread flooding and devastating farm operations

[30] Andrew C. Isenberg, "The Real Wealth of the World: Hydraulic Mining and the Environment in the Circum-Pacific Goldfields," in *A Global History of Gold Rushes*, ed. Benjamin Mountford and Stephen Tuffnell (Oakland: University of California Press, 2018), 216.
[31] Rickard, *Interviews with Mining Engineers*, 227.
[32] Rickard, *Interviews with Mining Engineers*, 117, 227.
[33] Malcolm Rohrbough, *Days of Gold: The California Gold Rush and the American Nation* (Berkeley: University of California Press, 1997), 197–229; Susan Lee Johnson, *Roaring Camp: The Social World of the California Gold Rush* (New York: W. W. Norton, 2000), 275–314.
[34] See also Mae M. Ngai, "Chinese Gold Miners and the 'Chinese Question' in Nineteenth-Century California and Victoria," *Journal of American History* 101, no. 4 (March 2015): 1082–1105.

downstream. Mercury contamination was also a significant issue.[35] While gold mining by no means represented the first anthropogenic changes to California's environment, in many cases accelerating already processes already in motion like grazing, hydraulic mining in particular was "undoubtedly the greatest harm."[36] Those who were affected by it organized and fought with the mine owners. This led to a series of legal conflicts between the Hydraulic Miners Association, representing mine owners, and the Anti-Debris Association of the Sacramento Valley that culminated in the San Francisco US Circuit Court's *Woodruff v. North Bloomfield Gravel Mining Company* decision of 1884. That opinion all but put an end to hydraulic mining in the state of California, representing what one historian called "the first successful attempts in modern American history to use the concept of general welfare to limit free capitalism."[37] While farmers celebrated Judge Sawyer's decision by setting off fireworks and packing taverns, over 20,000 now-unemployed miners left the northern Sierras in seek of work.[38] Among them were a few dozen mining engineers, furious that the federal government had impinged on their ability to extract minerals from the earth's crust.

After the Sawyer decision and the closure of North Bloomfield, Jennings worked for two years as the superintendent at the New Almaden quicksilver mine near San Jose, where mercury was mined to assist in refining California's gold.[39] In a privately circulated report that

[35] Adam M. Romero, "Beyond the Mother Lode: Synthetic Cyanide and the Chemicalization of California Gold Mining (1885-1905)," *California History* 95, no. 1 (Spring 2018): 2–24.
[36] Raymond F. Dasmann, "Environmental Changes before and after the Gold Rush," *California History* 77, no. 4 (December 1998), 120. For an early example of this ecological history, see Donald Worster, "Hydraulic Society in California: An Ecological Interpretation," *Agricultural History* 56, no. 3 (July 1982): 503–15.
[37] Robert L. Kelley, *Gold vs. Grain: The Hydraulic Mining Controversy in California's Sacramento Valley* (Glendale, CA: Arthur H. Clark, 1959), 13.
[38] David Vogel, *California Greenin': How the Golden State Became an Environmental Leader* (Princeton, NJ: Princeton University Press, 2019), 43.
[39] "Testimony of Hennen Jennings," in *A Contested Election in California*, 1887, 5–35.

prefigured his international reputation as a consulting engineer who compared working costs at mines around the world, Jennings noted "the workmen are seriously affected by the mercurial emanations from the mine, and do not work on an average over one day in three, and then only six hours at a time."[40] No mention was made of the consequences of mercury flowing into the Guadalupe River and into San Francisco Bay. Jennings' priorities were made clear when he recalled years later about marrying the daughter of a California "pioneer," Mary Coleman. Jennings joked that since the soil underneath the house she was born "was later hydraulicked away, so there is a doubt whether the place of her birth is Placer county or the Bay of San Francisco!"[41] Humor was evidently useful in allaying anxieties about the scale of environmental change.

While hydraulic gold mining and mercury mining came at enormous costs to the human and nonhuman world, hydraulicking was especially profitable for San Francisco capitalists. Mining engineers, who considered themselves allies of capital, were indignant that the Sawyer decision had put ended their run.[42] Henry Perkins, who had succeeded Smith in charge of North Bloomfield, recalled, "when the attacks of the farmers, assisted by the Federal government, against the hydraulic miners, who were charged with destroying farming land and injuring the rivers and harbors, became so harrassing and expensive that I saw that hydraulic mining in California would be no longer profitable."[43] Perceived "freedom" from state interference and regulation of mining was a common refrain among engineers who often thought they knew

[40] Hennen Jennings, *The Quicksilver Mines of Almaden and New Almaden: A Comparative View of Their Extent, Production, Costs of Work, Etc.* (San Francisco: Printed for Private Circulation, 1886), 10.
[41] Rickard, *Interviews with Mining Engineers*, 228.
[42] For more on engineers' ideology, see chapter 1 of this dissertation; Shenhav, *Manufacturing Rationality*; Grossman, *Mining the Borderlands*; Hendrickson, "Advance Agent of Expanding Empires."
[43] Rickard, *Interviews with Mining Engineers*, 414–15.

best. Mining engineer William Mein remembered his father, Captain Thomas Mein, as having followed Smith and Perkins to the El Callao gold mine in Venezuela on behalf of the Rothschild family as a result of the Sawyer decision.[44] Mein, Smith, Perkins, and Jennings all made their way to El Callao. Meanwhile, Michigander and Freiberg graduate Gardner F. Williams, who had been superintendent of another hydraulic mining company in Nevada County, was also rendered unemployed by the Sawyer decision. In 1884, he left California for the diamond fields of Kimberley and became the first US mining engineer in southern Africa.

Tailings in Johannesburg

Narratives of the rise of industrial gold mining and the ensuing urban growth in what is now Gauteng province have a few customary starting points. One is closer to the origin of the earth than it is to us: starting around 3 billion years ago (2985 Ma), the initial formation of the Mesoarchean Witwatersrand Basin, the geologic feature from which at least a third of the earth's gold has been extracted.[45] More common is the story of George Harrison, a prospector who found gold in an outcrop of the main reef on Langlaagte farm in 1886, touching off an influx of capital, speculators, miners, engineers, and others from the diamond fields in Kimberley, nearly 500km (300 miles) southwest.[46] Most narratives skip over entirely the deep

[44] William Wallace Mein, Reminiscences of William Wallace Mein: oral history, 1961, Columbia Center for Oral History; "The Debris Question," *Engineering and Mining Journal*, September 17, 1887, 44, no. 12, 200–1.
[45] The most up-to-date overview of this geology is Hartwig E. Frimmel, "The Witwatersrand Basin and Its Gold Deposits," in *The Archaean Geology of the Kaapvaal Craton, Southern Africa*, (Cham, Switzerland, Springer, 2019), 255–75.
[46] To take just one example from an excellent study, see Martin J. Murray, *City of Extremes: The Spatial Politics of Johannesburg* (Durham, NC: Duke University Press, 2011), 38.

history of the grasslands,[47] which supported large ungulate fauna until about a century ago,[48] or of the Sotho-Tswana people who lived in the region before Afrikaner settlers arrived after leaving the British Cape Colony.[49]

One of the first things an international visitor to Johannesburg is bound to notice upon leaving O. R. Tambo International Airport in Ekurhuleni and towards the CBD on the Albertina Sisulu Freeway, R24, is the sight of mine dumps (Image 3) visible on the horizon. At first, the dumps merely resemble hills. But if you drive just about anywhere along the "reef"—the east-west underground axis of gold transecting this car-dependent southern African metropolis—you'll soon see these are no ordinary hills. Uniform in shape, with a sandy composition, these "hills" are often bereft of any vegetation, and worryingly, are sometimes aflame. Even at from inside a car at 120kph, it's impossible to miss the fact that these enormous mine dumps, rising to heights of anywhere from 30 to 100 meters (100-300 feet), were put there by humans. The dumps are even the region's most distinguishing feature when viewed from space, as NASA reported when it published the findings of its Landsat program in 1976.[50] While the yellow-white sandy dumps composed of mine waste represent the most visible and immediate

[47] Paleoclimate records in the region are hard to come by and often contradictory. See Elysandre Puech et al., "Vegetation and Environmental Changes at the Middle Stone Age Site of Wonderkrater, Limpopo, South Africa," *Quaternary Research* 88, no. 2 (September 2017): 313.
[48] André F. Boshoff and Graham I.H. Kerley, "Lost Herds of the Highveld: Evidence from the Written, Historical Record," *African Journal of Wildlife Research* 45, no. 3 (October 2015): 287–300.
[49] On the precolonial Highveld, see Martin Legassick, "The Politics of a South African Frontier: The Griqua, the Sotho-Tswana and the Missionaries, 1780-1840: The Politics of a Frontier Zone," PhD Dissertation, University of California at Los Angeles, 1969; Paul S. Landau, *Popular Politics in the History of South Africa, 1400-1948* (Cambridge: Cambridge University Press, 2010), 1–73. On Afrikaners and the "Great Trek," see Hermann Giliomee, *The Afrikaners: Biography of a People* (Charlottesville: University of Virginia Press, 2003), 161–92. For a powerful methodological approach to understanding long term regional histories of Africa, see David L. Schoenbrun, "Conjuring the Modern in Africa: Durability and Rupture in Histories of Public Healing between the Great Lakes of East Africa," *American Historical Review* 111, no. 5 (December 2006): 1403–39.
[50] Nicholas M. Short et al., *Mission to Earth: Landsat Views the World* (Washington, D.C: Scientific and Technical Information Office, National Aeronautics and Space Administration, 1976), 388.

material product of this "instant city" that seemed to spring forth from the Highveld in the form of a gold mining camp in 1886, they have attracted curiously little attention from historians.[51]

Considering the sheer size of tailings dumps, mentions from anyone—novelists, journalists, geographers, and so on—are scarce, and historical analysis even harder to come by.[52] Writers frequently deploy them as metaphors, signifiers of artificiality and greed, or to regret the lack of pleasant views. Anti-apartheid activist and future South African President Nelson Mandela lamented that upon receiving his third banning order from the state in 1956, confining him to Johannesburg, "For the next sixty months I would be quarantined in the same district, seeing the same streets, *the same mine dumps on the horizon*, the same sky."[53] One of South Africa's best known artists, William Kentridge, recalls that as a child he was deprived of the four basic elements of European landscape painting—"shade, water, mountains, colour"—which are "completely absent" from the area around Johannesburg.[54] Most recently, Jonathan Cane, a South African art historian, writes of growing up in brown and dusty Johannesburg, longing for green and "dreaming of planting lawns over the mine dumps."[55] Before the dumps were lamented, however, they were celebrated: in 1936, the fiftieth anniversary of industrial gold mining and Johannesburg's "Jubilee Year," the dumps were an icon of progress and

[51] John Matshizika, "Instant City," in *Johannesburg: The Elusive Metropolis*, Sarah Nuttall and Achille Mbembe, eds. (Durham, NC: Duke University Press, 2008), 221.
[52] For an overview of what does exist, see Valentina Flora Angelucci, "Art and Literature of Johannesburg: The Telling of Tailings" (MsC thesis, Columbia University, 2019).
[53] Nelson Mandela, *Long Walk to Freedom: The Autobiography of Nelson Mandela* (New York: Little, Brown, 1994), 191. Emphasis mine.
[54] William Kentridge, "Meeting the World Halfway (A Johannesburg Biography)," 2010, https://www.kyotoprize.org/wp-content/uploads/2019/07/2010_C.pdf, 179.
[55] Jonathan Cane, *Civilising Grass: The Art of the Lawn on the South African Highveld* (Johannesburg: Wits University Press, 2019), 1.

development, at least in settler society.[56] That year, newspapers around the world carried boasts from South Africa about how the success of gold mining on the Rand was embodied in the dumps, which boosters claimed had surpassed the Egyptian pyramids.[57] Those same papers made no mention of the "demon dust" that plagued the city.

The Witwatersrand and the "Demon Dust"

Putting pressure on California's hydraulic mining operations did result in operations popping up in other places along the west coast of North America, as Andrew Isenberg has shown of British Columbia.[58] Less known is the story of the Lisbon-Berlyn Company, the first to introduce hydraulic mining on a large scale in South Africa as part of the Barberton gold rush that began in 1874. The Lisbon-Berlyn Company employed US engineers and US equipment. Future Randlord J. B. Taylor recalled that "Everything was being done on the Lisbon-Berlyn property on a grand scale. Hydraulic machinery, stamp batteries, and other mining machinery, together with a staff of American experts, arrived on the ground long before payable gold had been discovered."[59] This was a taste of what was to come in a few years' time on the Witwatersrand, 350km (just over 200 miles) to the west.

[56] On the occasion and accompanying Empire Exhibition, see Jennifer Robinson, "Johannesburg's 1936 Empire Exhibition: Interaction, Segregation and Modernity in a South African City," *Journal of Southern African Studies* 29, no. 3 (September 2003): 759–89.
[57] "Golden Johannesburg," *Hondo Anvil Daily Herald* (Hondo, TX), September 18, 1936, 10.
[58] Andrew C. Isenberg, "Afterword: Mining, Memory, and History," in *Mining North America: An Environmental History since 1522*, ed. J.R. McNeill and George Vrtis (Oakland: University of California Press, 2017), 400.
[59] Alpheus F. Williams, *Some Dreams Come True: Being a Sheaf of Stories Leading Up to the Discovery of Copper, Diamonds and Gold in Southern Africa, and of the Pioneers Who Took Part in the Excitement of Those Early Days* (Cape Town: Howard B. Timmins, 1949), 529, 531.

While California continued to further regulate mining operations in the decade after 1884, passing the Caminetti Act in 1893 to the continued displeasure of mining engineers, Johannesburg's mine owners found themselves in nearly the opposite situation in 1889.[60] Taken ten years after industrialized mining began, Johannesburg's 1896 census shows a population of 102,078, nearly half of whom were white settlers, roughly 40% African, 5% "Asiatic" (South Asian), along with a significant "mixed" population and just under a thousand "Malays" (Chinese). About 80 % were male. The census is suggestive of how Johannesburg was largely a city of arrivants, and prefigures the multitude of migrations as well as the racial patterns seen over the next several decades. Jennings had arrived from El Callao, where the forests had been cleared to make living conditions "comparatively safe for white men," and was soon joined by a number of the leading mining engineers from the United States, who took prominent roles and Jennings himself was elected the first president of the South African Association of Engineers and Architects in 1892.[61] As the *Proceedings* of their meetings show, over the next eight years it was US engineers in concert with a smaller number of British engineers that designed and implemented the technological solutions to the problem of deep level mining begun in 1889. Jennings is credited with bringing the MacArthur-Forrest cyanide process for extracting gold from ore to southern Africa, and also for organizing and electrifying the surface works of a great deal of the Rand's mines. Other US engineers, newly arrived from California, set world records in rapidly sinking shafts, while others made innovations on

[60] "Enforcing the Caminetti Act," *Mining and Scientific Press*, March 31, 1894, 194.
[61] Rickard, *Interviews with Mining Engineers*, 231.

ventilating deep level mines.[62] The Association was largely technical but collaborated with architects to design what they deemed suitable housing for the white working class, a collaboration that signaled larger designs and interests than simply mineral extraction. While mining capitalists later credited engineers like Jennings and Hammond with making much of their spectacular fortunes—making men like Julius Wernher and Alfred Beit some of the wealthiest men in 1890s London—historians have largely missed how central engineers were to the physical layout of the emergent city of Johannesburg, which for much of its history was largely synonymous with gold mining.[63]

It is not surprising, then, that the rich historical record of mining engineers and capitalists offers many clues to how mining engineers thought about the mass destruction involved in deep level mining and the consequences of excavating and pulverizing enormous quantities of rock.[64] As the first city in Africa where capital, labor, and industry existed together, mining engineers in and around Johannesburg had a firsthand view of the process.[65] While, as we will see, mining engineers and Randlords were not exposed to hazardous mining waste in the same way that others were, they lived much closer to the workscape than they had in California.[66] There, mining engineers preferred to live in Oakland, proximate to San Francisco but apart from its fog and pollution, and farther still from mining workscapes in places like

[62] For an overview of these technological changes, see Roger Burt, "Innovation or Imitation? Technological Dependency in the American Nonferrous Mining Industry," *Technology and Culture* 41, no. 2 (2000): 321–47.
[63] For a critical view on of the Randlords' enormous wealth and philanthropic contributions, see Jill Pellew, "Donors to an Imperial Project: Randlords as Benefactors to the Royal School of Mines, Imperial College of Science and Technology," in *Dethroning Historical Reputations: Universities, Museums and the Commemoration of Benefactors*, ed. Jill Pellew and Lawrence Goldman (School of Advanced Study, University of London, Institute of Historical Research, 2018), 35–46.
[64] The term "mass destruction" is borrowed from LeCain, *Mass Destruction*.
[65] Achille Mbembe, "Aesthetics of Superfluity," in *Johannesburg: The Elusive Metropolis* (Durham, NC: Duke University Press, 2008), 39.
[66] I borrow the term "workscape" from Andrews, *Killing for Coal*, 125.

Nevada County. In 1872, a proposal for construction of a smelter close to Oakland resulted in protestations from engineers and mine owners, who had concerns about the harms the smelter would have on their families.[67] In Johannesburg, mining engineers lived and played closer to the mines. Hammond, for instance, remembered that although work demands left little time for sports, occasionally a "polo match, gymkhana, and now and then a horse race were held at the Wanderers' Club. These social functions were usually made disagreeable by the constant dust from the bleak dry veldt and the 'tailing' piles of the mills."[68] The Wanderers' Club, still a fixture in the city's northern suburbs, is only about 10km (6 miles) from the main reef. Hammond's characterization of the dust as "disagreeable"—suggesting he did not believe it to be a serious health issue—was common. George Andrews, a British civil engineer in Johannesburg and a member of the Sanitary Institute of Great Britain, lamented in 1895 that one of the drawbacks to living in an otherwise "progressive town" was the "demon dust." Gesturing to the other engineers in the room, he jokingly added that "judging by the company he did not think it did much damage."[69]

Nevertheless, many contemporary visitors had a far less benign view of the dust problem. One visitor said he had "seen dust storms so thick that one could not see one's hand before one's face."[70] An 1893 visitor from Port Elizabeth said that dust was the single worst thing about Johannesburg, and the likely cause of all the sickness in the city.[71] While engineers believed it was their duty to "to direct the sources of nature for the benefit of mankind," in

[67] Gray Brechin, *Imperial San Francisco: Urban Power, Earthly Ruin* (Berkeley: University of California Press, 2006), 62.
[68] Hammond, *Autobiography*, 1:207.
[69] *Proceedings of the South African Association of Engineers and Architects*, Vol. 2 (1896), 165.
[70] *Johannesburg: One Hundred Years* (Johannesburg: Chris van Rensburg Publications, 1986), 33.
[71] "A Trip to the North," *Port Elizabeth Telegraph and Eastern Province Standard*, June 8, 1893.

practice this often led to conflict. As early as 1891 the South African Republic began regulating tailings piles, requiring mining companies to purchase *bewaarplatsen* licenses to store tailings.[72] This had more to do with land use than public health however, as there was no environmental regulation in place. The next year, the mining areas and the growing town were legally separated. Still, mining engineers, most from Great Britain, were concerned with the negative consequences of tailings. It was an English architect, Arthur Reid, who met with the engineers, who in 1892 foresaw many of the future problems, even if he did not understand acid mine drainage (AMD), the properties of radionuclides, or the photochemical degradation of cyanides. Reid suspected that the health of those living nearby "must be affected by the fine dust that is displaced by wind and conveyed in suspension […] as well as by the miasma that must arise from tailings in hot weather" and carried by wind. The municipal water supply, too, could be poisoned from tailings treated with cyanide. Reid acknowledged that although tailings grew to twice the volume of the original rock, he nevertheless proposed storing tailings in excavations inside unused mines themselves—known in the language of mining as "stopes"—as a matter of "public interest."[73] In any event, he said, tailings could expose mining firms to liability, and unless the question was dealt with soon, the problem would only grow along with the mining industry. The other engineers and scientists present agreed that tailings drift was a "very serious" question, but immediately some problems were recognized. For one, storing tailings in stopes was deemed too expensive. A chemist dismissed cyanide as a solution, given that the

[72] *The Mining Industry: Evidence and Report of the Industrial Commission of Enquiry*, (Johannesburg: Witwatersrand Chamber of Mines, 1897), 481.
[73] Arthur Reid, "Disposal of Tailings," *Proceedings of the South African Association of Engineers and Architects*, 1 (1893), 56–58.

chemical is a hazard to human health.[74] The largest issue was that, as tailings contained some amount of gold, they were bound to be re-treated as technology improved. Ultimately it was decided that vegetation should be looked into to stop the drift, and by the middle of the next year, the gardener of the Sanitary Board was experimenting with agave as a potential fix.[75]

By 1894, it became clear that the mining industry had little interest in containing tailings. The industry's only use for them was as a substitute for lumber: "It was of great economic advantage to the Rand mining industry that, compared with other mining districts, but little lumber was required for timbering operations. Timber in South Africa was scarce and expensive; it had to be imported, principally from America and Australia. Almost no timber is used in the deep mines to prevent caving. Tailings, or refuse from the crushed rock, are lowered into the workings and used as filling. These may be supplemented by waste rock or reinforced by concrete pillars."[76] When the issue came before the Mine Managers' Association, "the general feeling was that the mining industry is taxed to such a great extent that they could not voluntarily undertake to do anything" about tailings, unless the "Government would take up the matter and give a subsidy for the purpose of preventing the tailings from blowing about." Planting vegetation to cover the dumps and mitigate the dust hazard was considered to be of little use, given that the "tailing heaps grow so fast […] that we should have to be continually planting."[77]

[74] It is now understood that although cyanide breaks down when exposed to ultraviolet light (usually the sun), it can break down to other compounds that are hazardous to organic lifeforms.
[75] *Proceedings of the South African Association of Engineers and Architects*, 1, 141–42.
[76] Hammond, *Autobiography*, 1:303.
[77] "Discussion on Mr. A. H. Reid's Address," *Proceedings of the South African Association of Engineers and Architects* 2, August 15, 1894, 14–16.

Rather than attempting to stop the runaway train of tailings and dust, one proposed solution was to engineer their way around the problem. Johannesburg's sanitation system was designed, in part, to remedy the ills believed to be wrought by dust. An engineer, J. Woodward Hill asked rhetorically, in defense of a large supply of water for domestic purposes like street watering, "In Johannesburg itself, what causes more disease than these constant dust storms? Every particle of dust almost laden with microbes in some form or other, and the only remedy for that is a good water supply."[78] A shortage of water had long been a concern on the Rand, as it was necessary for gold production as well as drinking water and sanitation. In 1898, Californian William Hammond Hall was trying to bring water from the Klip River south of the city to Johannesburg.[79] At a meeting of the Chemical and Metallurgical Society, Johnson began his brief paper on economizing water in the gold concentration process by stating the obvious: "these fields are not over-well supplied with water generally." A commenter agreed that the matter was vital, calling the paper "very interesting and instructive, as the question of economising water is of the utmost importance for the local industry in view of the scarcity of water on the Rand."[80] The industry's own demand for water undermined using it elsewhere. So important was water to mining that engineers were typically more concerned about purity of the city's water for use the cyanide process than they were of cyanide getting into the drinking water.[81]

[78] *Proceedings of the South African Association of Engineers*, 3, 179.
[79] "Foreign Mining News," *Engineering and Mining Journal*, May 21, 1898, 623.
[80] "A Means of Economising Water in Concentration," *Proceedings of the Chemical and Metallurgical Society of South Africa*, 2, 439–40.
[81] "Rand Mine Waters," *Proceedings of the South African Association of Engineers*, 14 (1910), 36.

Water shortages notwithstanding, at any event the mining industry did not want to face the dust problem head on. Moreover, the mining industry, represented by the Chamber of Mines, actively resisted any limits being placed on its environmental practices. In 1897, the Volksraad (in essence, Parliament of the South African Republic) proposed abolishing the legal immunity it had thus far conferred on the mining industry from polluting waterways, and also amending existing regulation to mandate "the covering up of slimes and tailings."[82] The Chamber responded by pointing out that this would "would cause great inconvenience and loss to mining companies," and blamed "those persons who have built in the immediate vicinity of the mines" for their poor decisions. Perhaps owing to the difficult economic climate, or the political questions arising from the Industrial Commission, the Volksraad decided to postpone implementation.[83]

Unsure of when or if the South African Republic would pass the law, engineers again made some technical changes. H. R. Skinner advocated that if the law passed, with "judicious and careful application of the slimes sludge, it may be found possible to do away with nearly all the obnoxious effects of the sand dumps." With government funding, Skinner believed it would be possible to cover the ground with sand and use the space to build on, or even to dump the tailings "some miles away." [84] Charles Butters, a University of California-educated metallurgist recruited to South Africa by Jennings, still believed that grass or weeds of some kind could

[82] *Chamber of Mines of the South African Republic: Ninth Annual Report for the Year Ending 31st December, 1897* (Johannesburg: Argus Printing, 1898).
[83] TCMAR 9, 351–52.
[84] H. R. Skinner, "Handling and Disposal of Tailings, Sands, and Slimes on the Goldfields of the Witwatersrand," *Proceedings of the South African Association of Engineers,* 4, (October 27, 1897), 59–60.

cover the dumps.[85] Neither could imagine how dramatically the scale of the problem would grow in just a few years.

The South African War of 1899-1902 resulted in British imperial control of the goldfields and in short order, "mining capitalism had been installed as the dominant mode of production in southern Africa."[86] Seemingly confident that it had an ally in power, the Chamber of Mines requested that it be separated from Lord Milner's plan to expand the area of Johannesburg. The Chamber protested that, surely, these industrial areas were not suitable to living. It turned out that the imperial authorities were actually accepting of the problems of industrialization. The "solution" involved a growing reliance of race and class segregation, done in the name of public health and urban planning.

US mining engineers continued to have the boldest visions for the transformation of the land in and around Johannesburg. In 1904, as Milner's reconstruction policies accelerated and Johannesburg—rather than Pretoria, which had been the seat of power under Kruger—came to be the hub of both capital and government in the Transvaal, the Chamber of Mines continued to resist plans to settle the city. The Chamber cited the opinion of US engineer George Webber, who had succeeded Jennings as manager of the El Callao gold mine in 1889. In Webber's view, "practically the whole surface area would be needed for the works, and for depositing the waste products of the mines."[87] That same year, the Johannesburg Housing Commission issued a report about situating housing next to the mines, noting, "There are certain obvious

[85] "Discussion on Mr. H. R. Skinner's Paper on 'The Handling and Disposal of Tailings," *Proceedings of the South African Association of Engineers* 4 (January 26, 1898), 138.
[86] Van Onselen, *Studies in the Social and Economic History of the Witwatersrand, 1886-1914*, 108.
[87] *Transvaal Chamber of Mines Fifteenth Annual Report for the Year 1904* (Johannesburg, 1905), *lii*.

disadvantages in attempting to place any considerable population on land covered with mining dumps, and generally made undesirable for residential purposes by mining operations."[88]

An April 1904 Johannesburg town council meeting that discussed the "dust evil" echoed many of these concerns. In the course of debating a motion "to take immediate steps" to remove the dust from city streets, one resident, Mr. Buckland, was especially incensed by the "curse" of the dust, pointing out that it was an annual "tax" on shopkeepers and householders, as well as a "continual discomfort" that "kept the women and children from the joys of life." Worse, the dust "lowered the vitality of the population" and exacerbated residents' propensity to disease, furnishing "the graveyard a regular undiminishing harvest." Buckland pointed out that the "five dusty months" ranging from July to November had "three times as many deaths from pneumonia" as the other seven. Buckland also claimed that a doctor warned him "that many people living now would be in their graves by November next on account of the dust." These deaths were not as worrisome as the "vast scheme" that would be required to undertake. One fretted that the dust would "be always with them," pointing out that in the month of March alone "between 4,000 and 5,000 loads of dust were removed from the centre of town." The continual problem of a shortage of water, in high demand by mining firms, only worsened the matter. Another pointed out that "watering of the streets" to keep dust down was more expensive in Johannesburg than elsewhere owing to the high price of water. A critic perceptively remarked that the "committee appeared to be afraid of this monster." Everyone

[88] *Transvaal Chamber of Mines Fifteenth Annual Report for the Year 1904* (Johannesburg, 1905), 234.

acknowledged the monster existed and posed a danger, but it had simply grown too big to be slain.[89]

The lack of action on tailings and dust meant that the mining industry got its wish, for a time: that same year slum clearance in the name of sanitation proceeded in the black and Asian neighborhoods close to the center of the city. As Keith Beavon notes in his history of the city, "By 1904 the geographical foundations of modern Johannesburg were complete."[90] Areas along the reef east and west of the city had been opened up, or left open, for mining. Poor white *bywoners* (indigent landless Afrikaners) as well as nonwhites had been pushed to the south of the city, where they dealt with the brunt of tailings dust.

In the years after 1904, once the proportionally tiny managerial class whites had left suburbs like Doornfontein, to the east, and moved north to join Jennings and the Randlords on the ridge of Parktown, facing the Magaliesburg mountain range and away from the mine dumps, concern about the hazards of tailings seemed to decline.[91] Indeed, the harms of dust could be played up or down to suit the needs of industry. Confronted with white working-class outrage from around the British settler world, as well as humanitarian concern at the import of around 60,000 indentured Chinese mine laborers, the Chamber of Mines blamed high death rates among workers on wind and dust in combination with the "racial factor."[92] In 1908, Dr. Charles Porter, the city's Medical Officer of Health, testified to the harm tailings dust was having on suburbs to the south of the city, Ophirton, Fordsburg, and Booysen's Reserve. Porter

[89] "The Dust Evil," *Rand Daily Mail*, April 29, 1904.
[90] Keith Beavon, *Johannesburg: The Making and Shaping of the City* (Pretoria: University of South Africa Press, 2004), 78–79.
[91] Benjamin Arnold et al., *Park Town, 1892-1972: A Social and Pictorial History* (Johannesburg: Studio Thirty Five, 1972).
[92] *Transvaal Chamber of Mines Fifteenth Annual Report for the Year 1904,* 87.

admitted that windy days brought much material to residents. Pressed on the health risks involved, Porter responded by saying "that it is an annoyance more than an injury to health. Of course, people who are delicate would be annoyed by it, and perhaps their health would suffer." Porter conceded that earlier plans to vegetate the dumps had failed but, in any case, wind carried the material at most a mile away.[93] Even the complainant, a Mr. Hofmeyr, allowed that to do much about the problem of mine dumps would come at too much of an expense. The monster had yet to be slain.

One of the most significant consequences of the effects of mining pollution was the increasing racial and class segregation of the city in response. Historians of urban segregation have not adequately dealt with the intersection of industrial pollution, pneumonic plague, and racial segregation. As many contemporaries understood, and medical science has since confirmed, the dust problem exacerbated susceptibility to bacterial and viral infections like pneumonic plague.[94] As Africans fitfully to move into the city they chiefly moved to the areas that had been abandoned or made cheaper due to their proximity to tailings. This was what allowed white Johannesburg to celebrate mine dumps as the new pyramids in 1936—it was not them who dealt with the harm. The National Party's electoral victory in 1948 was followed by

[93] *Transvaal Chamber of Mines Twentieth Annual Report for the Year 1909* (Johannesburg, 1910), 112–16.
[94] A. J. Christopher, "Roots of Urban Segregation: South Africa at Union, 1910," *Journal of Historical Geography* 14, no. 2 (April 1988): 151–69; Susan Parnell, "Creating Racial Privilege: The Origins of South African Public Health and Town Planning Legislation," *Journal of Southern African Studies* 19, no. 3 (September 1993): 471–88, Susan Parnell, "Race, Power and Urban Control: Johannesburg's Inner City Slum-Yards, 1910–1923," *Journal of Southern African Studies* 29, no. 3 (September 2003): 615–37; Paul Maylam, "Explaining the Apartheid City: 20 Years of South African Urban Historiography," *Journal of Southern African Studies* 21, no. 1, (1995): 19–38; Nightingale, *Segregation*, 229–60; Howard Phillips, "Locating the Location of a South African Location: The Paradoxical Pre-History of Soweto," *Urban History* 41, no. 2 (May 2014): 311–32; Dube Francis, "Public Health and Racial Segregation in South Africa: Mahatma (M. K.) Gandhi Debates Colonial Authorities on Public Health Measures, 1896-1904," *Journal of the Historical Society of Nigeria* 21 (2012): 21–40; Charles M. Evans, Joseph R. Egan, and Ian Hall, "Pneumonic Plague in Johannesburg, South Africa, 1904," *Emerging Infectious Diseases* 24, no. 1 (January 2018).

intensifying and increasingly authoritarian residential segregation throughout the 1950s, removing old "locations" and constructing "modern" townships farther from white towns.[95] The end of apartheid in 1990 only accelerated these spatial and racial patterns, as whites fled for the suburbs or left the country entirely, and some Africans moved out of the townships and homelands and into the city seeking economic opportunity. Many continue to arrive from other sub-Saharan Africa nations to do the same. These demographic and economic pressures are one part of the reason why mine-related disease has become such a concern over the last decade, especially to the poorest residents of the city who live on and near the dumps of tailings, and whose health has been severely compromised as a result.

The devastating health effects of toxic dust, acid mine drainage (AMD), and radioactivity arising from mine waste are not lost on residents. One Soweto resident, Mavis Sibaya, said the dust "makes your skin very itchy" and "the children cough badly."[96] There are a host of respiratory and neurologic diseases associated with mine waste, and comparisons are commonly made to Chernobyl.[97] A recent survey of residents in the Gauteng City-Region found that nearly half agreed with the statement that "mining waste poses a threat to my community."[98] Although the concept of "environmental justice" has been floating around since the early 1990s when it was imported to South Africa from the United States, and Section 24 of

[95] Deborah Posel, *The Making of Apartheid, 1948-1961: Conflict and Compromise* (Oxford: Clarendon Press, 1991); Philip Bonner and Noor Nieftagodien, with Sello Mathabatha, *Ekurhuleni: The Making of an Urban Region* (Johannesburg: Wits University Press, 2012), 93–101; Noor Nieftagodien and Sally Gaule, *Orlando West, Soweto: An Illustrated History* (Johannesburg: Wits University Press, 2012).
[96] "Joburg's Iconic Mine Dumps Are a Health Risk, Say Activists," *Mail & Guardian*, December 14, 2012, https://mg.co.za/article/2012-12-14-00-citys-iconic-mine-dumps-are-a-health-risk-say-activists/.
[97] For one example among many see "Playing Roulette with Our Water," *Independent Online*, October 11, 2009, https://www.iol.co.za/news/south-africa/playing-roulette-with-our-water-461081.
[98] Kerry Bobbins and Guy Trangoš, "Mining Landscapes of the Gauteng City-Region" (Gauteng City-Region Observatory, January 2018), 104, https://www.gcro.ac.za/m/documents/Mining_Landscapes_of_the_GCR_web.pdf.

South Africa's widely admired 1996 constitution guarantees that "Everyone has the right to an environment that is not harmful to their health," environmental politics in South Africa remain coalescent at best.[99] The race and class politics that trouble environmental activism in North America are arguably only more acute in South Africa.[100] As this chapter has demonstrated, however, many black South Africans are themselves pushing for what westerners might call "environmental justice." Historians of Africa and the environment would do well to follow their lead.

As one of the fiercest settler critics of mining capitalists on the early twentieth century Rand, William Scully bid farewell to the Ridge of the White Waters in search of "less strenuous climes," he reflected on the devastation wrought by some humans on other humans, as well as the earth. In the Standard Bank vaults, Scully handled ingots of gold produced by the Rand's mines, and wondered what the "cost in human life" had been for the "loaf-like lump of metal, so heavy and so bright." Scully recognized that in the shadow of the mine, human life was "often as much a waste product as is the material forming the dumps." As he departed, Scully looked forward to a distant future where "this monstrous infestation by greed-driven human creatures will be written of as but a trifling episode between untroubled ages too vast for human computation:"

> I can see those brightly lit structures in which the monstrous machine-entities ceaselessly strive, shining out along your eastern contours like the burnished scales of that vast world-serpent the Eddas tell of. The days and nights of thy passion are many and full of woe, but again, in some cleaner future, the dross wherewith thou art defiled will disappear and thou wilt come to merit thy old name. Man, with his ravaging

[99] Jacklyn Cock, "Challenging Environmental Injustice and Inequality in Contemporary South Africa," in *New South African Review 6* (Johannesburg: Wits University Press, 2018), 252–67.
[100] For more on this issue see Lesley Green, *Rock|Water|Life: Ecology and Humanities for a Decolonial South Africa* (Durham, NC: Duke University Press, 2020).

> engines, his tragic futility, his greed, and his self-inflicted pain will pass like a dream, and Peace will resume her sway. The dewfall and the rain, shed alike on the just and the unjust—on the wild lily of the veld and the livid dump—will lave thy scars and re-create beauty out of thy ruin. When thy travail is at an end the faithful sky will assoil thee and the unbridled winds of heaven bring thee balm.[101]

Few observers were quite as poetic as Scully, but the passage shows that he, along with so many others, past and present, were aware of the "self-inflicted pain" of white extractivism. In his history of mining and the environment in the United States, *Gambling on Ore*, Kent Curtis inquires as to how the country became a "mining society" with "extraction" as "its primary economic mode" by 1910. Curtis laments that somewhere along the way, "the anxious scramble to stay ahead of uncertainties and stabilize instabilities might have given us pause that something was afoot."[102] In California's Sierra Nevada and in South Africa's Rand, the imperatives of capital and extraction overrode any hesitations engineers and others had about the damage. The difference between the two is that legislation—the Sawyer decision—curtailed such destruction in California, but actively encouraged it on the Rand.

This chapter has shown that it is possible to reconstruct the beginnings of this episode of slow violence. Contrary to what Jessica Teisch has argued in an otherwise pathbreaking work on US engineers abroad, Californian engineers like Jennings, Hall, and others, did not *fail* at creating a new California in South Africa. Rather the colonial space of the Rand especially between 1902 and 1907 allowed white extractivists the "freedom" to pursue their ambitions for material and economic development far beyond anything possible back home.[103] Likewise, future histories of the "mineral revolution" in southern Africa will need to be written with a

[101] William Charles Scully, *The Ridge of the White Waters* (London: Stanley Paul, 1912), 129, 133, 263–64.
[102] Curtis, *Gambling on Ore*, 9, 208.
[103] Teisch, *Engineering Nature*, 97–130.

view to the current struggles of South Africans, who face the kinds of environmental racism described here but also severe water shortages and air pollution, all of which is forecast to get worse as the planet's climate crisis deepens. Above all, we need a history adequate to "an idea of the Earth as that which is common to us, as our communal condition."[104]

[104] Mbembe, *Necropolitics*, 189.

Image

Image 3: Johannesburg's Mine Dumps in 1910

J. Wilbur Read, *The Reef at Johannesburg (Recto); Ancient Ruins at Mptone, Rhodesia (Verso)*, about 1910, about 1910, J. Paul Getty Museum, https://www.getty.edu/art/collection/objects/92380/j-wilbur-read-the-reef-at-johannesburg-recto-ancient-ruins-at-mptone-rhodesia-verso-american-about-1910/.

Chapter 4. Cornerstone of That New Imperialism: US Mining Engineers and Race Management, 1870-1903

At a 1907 meeting of engineers held in the offices of the Transvaal Chamber of Mines in Johannesburg, Edgar Laschinger paused to look back over the first quarter-century of gold mining on South Africa's Witwatersrand Basin. Laschinger's appraisal of the central issue was in fact not dissimilar to the view of many historians since then: "One of the greatest questions in South Africa has been and is, labour." Unsurprisingly, the process of extracting and processing the gold contained in what remains the world's largest known ore province involved an extraordinary amount of work.[1] However Laschinger also recognized a significant approach to that "question" that most historians have not apprehended: namely that "To an overwhelming extent, this is an engineering problem."[2]

Laschinger's observation and, indeed his career, upend familiar understandings of southern Africa's mineral revolution and moreover, the relationship between engineering and labor management. Laschinger first arrived in Johannesburg in 1895, just two years after finishing his undergraduate degree in civil engineering at the University of Toronto.[3] Born in the small southwestern Ontario town of Mitchell, Laschinger is essentially unknown to historians, but in his time was known for his hydraulic engineering talent, solving the issue of water in the deep mine shafts, and was generally well regarded by his peers in the South African Association of Engineers, who elected him president in 1909.[4] A return visit to the University of Toronto for

[1] Frimmel, "The Witwatersrand Basin and Its Gold Deposits."
[2] "Address by E.J. Laschinger, M.E., Vice-President," *Proceedings of the South African Association of Engineers*, 13, August 3, 1907, 2–5.
[3] Edgar Jacob Laschinger, University of Toronto Archives, Box 219, File 86, A73-0026.
[4] See for instance E. J. Laschinger, "Water Columns for Deep Level Mines," *Proceedings of the South African Association of Engineers*, May 1909, 209.

a master's degree in mechanical engineering, awarded in 1905, may have been where Laschinger became acquainted with the thinking of another, much better known mechanical engineer, Harrington Emerson. Emerson was then a major figure in efficiency engineering but not yet known outside of engineering circles, as the popularization of scientific management and efficiency in US culture only began with the Eastern Rate Case in 1911, and an efficiency fair in New York City in 1914.[5] Laschinger may have functioned as the link between efficiency and mechanical engineering and mining engineers, bringing the concept and language to the gold mines of the Rand in the years between 1905 and 1909. Although the gathered engineers in Johannesburg may not have been familiar with "efficiency engineering" and Frederick Taylor's scientific management, the methods would have sounded quite familiar given that they had decades of experience attempting to optimize the human element of mineral extraction.

This chapter locates the functional origins of the brand of rationality Laschinger described in the mercury mines and gold fields of 1870s California, where modern, professionalizing engineering intersected with residual forms of racialized labor management with roots on plantations. There, engineering rationality was applied to both the earth and the humans who labored to extract its metals, continuing patterns of white male extractivism. Laschinger recognized the nature of this when he noted that, "To do the best with labour, the engineer must understand the human machine," which he allowed "is a most difficult and complex matter, as it is impossible to separate the machine from the humanity." Accordingly, Laschinger believed, it behooved engineers to learn as much as they could about the living

[5] Harrington Emerson, *Efficiency as a Basis for Operation and Wages*, (New York: The Engineering Magazine, 1908); Harrington Emerson, *The Twelve Principles of Efficiency*, (New York: The Engineering Magazine, 1911). On Emerson and efficiency engineering, see Shenhav, *Manufacturing Rationality*, 93–97.

instruments of extraction: "the better the human machine is understood the more efficiently it may be used."[6] In the late nineteenth century, no country on earth was as renowned for its purported knowledge about racialized workers as the United States, which played a significant role in the export of this practice. This way humans were equated with nature was the flip side of the coin that, as we saw in the previous chapter (chapter 3), engineers viewed themselves as mediators between nature and humans.[7]

The tight linkages between engineering, management, and empire were best expressed by W. E. B. Du Bois, who described a "new American industrial empire" in the years following the violent overthrow of Reconstruction in 1876 rested upon, as the introduction to this dissertation described. Du Bois apprehended that "the immense profit from this new exploitation and world-wide commerce enabled of a guild of millionaires to engage the greatest engineers, the wisest men of science, as well as pay high wage to the more intelligent labor." That industrial empire soon "became the cornerstone of that new imperialism which is subjecting the labor of yellow, brown and black peoples to the dictation of capitalism organized on a world basis."[8] In other words, using applied scientists to control and manage labor was the basis on which empire and capitalism expanded in the late-nineteenth and early-twentieth centuries.

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[6] "Address by E. J. Laschinger, M.E., Vice-President," *Proceedings of the South African Association of Engineers*, August 3, 1907, 2–5.

[7] Picon, "Engineers and Engineering History," 431.

[8] W. E. B. Du Bois, *Black Reconstruction in America, 1860-1880* (New York: Free Press, 1935), 585, 622, 631, 634. On "race management" see Roediger and Esch, *Production of Difference*. For an excellent consideration of the theoretical issues, see Elizabeth Esch and David Roediger, "One Symptom of Originality: Race and the Management of Labour in the History of the United States," *Historical Materialism* 17, no. 4 (2009): 3–43.

This chapter turns first to California in the 1860s and especially 1870s to examine where the methods and networks of white extractivism's race management regimes first cohered. To understand the ideology of white extractivism, however, it is necessary to consider the slaveholding's south's defense of slavery in a world which, however slowly and fitfully, was transitioning to wage labor: as Du Bois wrote, "the South had but one argument against following modern civilization in this yielding to the demand of laboring humanity: it insisted on the efficiency of Negro labor for ordinary toil and on its essential equality in physical condition with the average labor of Europe and America."[9] This is the ideological basis for Jennings—and the other US mining engineers who testified at the Industrial Commission—who offered a defense of what black workers could do.

This chapter is the first of two that consider how mining engineers applied engineering and management techniques rooted in white male extractivism to racially segmented workforces. It is told in three parts: California; Venezuela and Kimberley; and the Rand, 1889-1902. The first section begins with the New Almaden mercury mine and North Bloomfield Hydraulic Mining Company in 1860s California, where these networks and practices first coalesced, it then considers El Callao gold mine in Venezuela, where workers were imported for the first time by these engineers. From there, the chapter moves to industrialized diamond mining in Kimberley, South Africa, where a mining engineer from the US, Gardner F. Williams, managed the De Beers Consolidated mine, simultaneously modernizing the mine, dividing the workforce, and suppressing organized labor. Many historians have shown how Kimberley functioned as a source of capital, labor, and expertise for gold mining on the Rand. However,

[9] Du Bois, *Black Reconstruction*, 38.

none have yet to connect Williams to the much larger cohort of US engineers that Williams in turn connected the Rand's mine owners with, who themselves played a leading role in engineering and managing the Rand's mines and workers in the 1890s, on the eve of the South African War.

California Mining and Continental Imperialism, ca. 1860-1885

Mining in California in this period must be understood as part of the story of emancipation, Reconstruction, and growing US empire.[10] Extractive industry was at the forefront of making antebellum property compatible with emancipation, as Emma Teitelman has shown in the case of notoriously anti-union mining company Phelps, Dodge, & Co., underlining the importance of land privatization to southern and western Reconstruction.[11]

Hennen Jennings' first job after graduating from Harvard's Lawrence Scientific School was, he recalled, "chiefly clerical." Thanks to his connection with Hamilton Smith, hydraulic engineering for the mine, Jennings was hired at the North Bloomfield Company, a hydraulic mining operation in Nevada County that in the 1870s was the largest in California,[12] Jennings was responsible for "the issuance of supplies and keeping of pay-rolls of the white men and Chinamen." It was likely Jennings' first exposure to this kind of racial accounting, but he acknowledged that it was formational: "This work in accountancy, coupled with what I obtained at North Bloomfield later, satisfies me that one of the most valuable experiences a young

[10] Karuka, *Empire's Tracks*; Jessica M. Kim, *Imperial Metropolis: Los Angeles, Mexico, and the Borderlands of American Empire, 1865-1941* (Chapel Hill: University of North Carolina Press, 2019); Lynn M. Hudson, *West of Jim Crow: The Fight against California's Color Line* (Urbana: University of Illinois Press, 2020).
[11] Emma Teitelman, "The Properties of Capitalism: Industrial Enclosures in the South and the West after the American Civil War," *Journal of American History* 106, no. 4 (March 2020): 879–900.
[12] Andrew C. Isenberg, *Mining California: An Ecological History*, 35. On Smith at North Bloomfield, see Hamilton Smith Jr., *An Account of the Operations of the North Bloomfield Gravel Mining Company*, 1875.

engineer can obtain is a good insight into accounts and commercial matters at the very outset of his career."[13] It functioned as good preparation for his next position at the New Almaden.

The New Almaden took its name from the famed Almaden quicksilver (mercury) mine in Spain, described by geologist and surveyor of the New Almaden George Ferdinand Becker as "the great quicksilver mine of the world," which had been producing since at least 415 BCE.[14] The New Almaden, near present-day San Jose, was used as a source of cinnabar by Ohlones, a group of indigenous Northern Californians, for paint long before it was by first mined by Mexican miners in the 1820s, and following the Mexican-American War of 1846-48, by Anglo Americans.[15] The New Almaden is best known as the subject of some of Mary Hallock Foote's sketches and descriptions of mining life that were widely circulated in places like *Scribner's* magazine. Her views were gleaned from living in the camp of miners from Cornwall—the "Cornish camp"—with her husband, mining engineer Arthur De Wint Foote. Foote's impressions of the New Almaden reveal that it was not at all like most other California mines, which were largely unionized and excluded non-white workers. What stood out to Foote was the "curious mixture of races gathered" at the New Almaden, "all living under a common rule, with the same work and the same general influences, yet as distinctly national as if each occupied its own corner of the earth."[16] Foote's exoticized views show how separately each of

[13] Rickard, *Interviews with Mining Engineers*, 225–26.
[14] George F. Becker, *Geology of the Quicksilver Deposits of the Pacific Slope, with an Atlas* (Washington, D.C: Government Printing Office, 1888), 4.
[15] For the indigenous history of the New Almaden, see Mary L. Coomes, "From Pooyi to the New Almaden Mercury Mine: Cinnabar, Economics, and Culture in California to 1920" (PhD Dissertation, University of Michigan, 1999). For more on this see Tomás Almaguer, *Racial Fault Lines: The Historical Origins of White Supremacy in California* (Berkeley: University of California Press, 1994); Laura E. Gomez, *Manifest Destinies: The Making of the Mexican American Race* (New York: NYU Press, 2008).
[16] Mary Hallock Foote, *New Almaden: Or, A California Mining Camp* (reprint of February 1878 *Scribner's* article), 1878, 480.

the Mexican, Chinese, and Cornish camps were from one another. While each group ostensibly worked at the same mine, they were kept separate through the spatial organization of the living quarters, rates of pay, and types of labor performed. The extent of a racial division of labor was visible aboveground, apparent in Foote's remark that "a Mexican brought our wood—of course a Chinaman chopped it."[17] The New Almaden mine's singular characteristics made it the ideal laboratory for white extractivism as a site for comparing and calculating the putative working characteristics of various racial and ethnic groups.

The New Almaden stood out on two fronts: its reliance on a contract pay system—rather wage labor was far more common—where compensation was given to groups of miners organized into companies and relatedly, its intensely racialized workforce. This can be partly explained by the incomplete transition from Mexican ownership to that of a British firm, Barron, Forbes, and Co. in the 1850s. A contract system was a common feature of Spanish colonial mining operations, and in the 1850s with rising pressure, owners allowed more white workers. Certain types of contracts were frequently awarded to specific racial or ethnic groups.[18] In 1865, there were twenty-eight nationalities working at the mine, as John Ross Browne attested in his description of an 1865 visit. Further, Browne noted that the takeover of the mine by the Quicksilver Mining Company in 1863 resulted in increasing systematization of work under new management.[19] As Andrew Johnston has argued of the New Almaden, "No other mine in California, or in the American West, operated on a major contract system or was

[17] Foote, *New Almaden*, 490.
[18] Stephen J. Pitti, *The Devil in Silicon Valley: Northern California, Race, and Mexican Americans* (Princeton, NJ: Princeton University Press, 2003), 27–28; Andrew Scott Johnston, *Mercury and the Making of California: Mining, Landscape, and Race, 1840–1890* (Boulder: University Press of Colorado, 2013), 137–70.
[19] J. Ross Browne, "Down in the Cinnabar Mines: A Visit to New Almaden in 1865," *Harper's Magazine*, 1865, 549–50.

racialized in this way."[20] But at the New Almaden, such a racially- and ethnically-regimented workforce was just the kind of place for Jennings' engineering-derived method of management.[21]

Jennings came to the New Almaden in 1877 through a connection with his old family friend, Hamilton Smith, and worked as assistant surveyor under Ross E. Browne, son of John Ross Browne.[22] As superintendent, Jennings carried out a comparison of the working costs of the two Almadens. Jennings published this as *The Quicksilver Mines of New Almaden: A Comparative View of their Extent, Production, Costs of Work, Etc*. While the New Almaden was in "desperate condition," Jennings believed that "in no mine on this coast are similar results obtained for less money." In this case, bringing in less skilled workers was not supported by this comparison, as Jennings concluded that "the accomplishment of cheap labor at Almaden, Spain, is certainly not encouraging."[23] The results of the comparative exercise were widely appreciated, with the *Engineering and Mining Journal* reflecting, "The history of a successful mine is always attractive, but the history of a successful poor mine is a story that has a far wider interest, for it shows how success is achieved by skill and economy where the conditions are unfavorable, and it teaches many lessons that have extended application."[24] The lessons of the New Almaden would indeed be applied widely.

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[20] Johnston, *Mercury and the Making of California*, 185.
[21] For an overview of Colorado mine laborers and labor organizing in this period as it relates to race and class, see Alexander Saxton, *The Rise and Fall of the White Republic: Class Politics and Mass Culture in Nineteenth-Century America* (London: Verso, 1990), 269–319.
[22] *A Contested Election in California* (Santa Clara, CA, 1887), 6.
[23] Hennen Jennings, *The Quicksilver Mines of Almaden and New Almaden: A Comparative View of Their Extent, Production, Costs of Work, Etc.* (San Francisco: Printed for Private Circulation, 1886).
[24] "The Quicksilver Mines of New Almaden, California," *Engineering and Mining Journal* 47 (January 5, 1889): 10–11.

El Callao, Venezuela, and Kimberley, South Africa

El Callao, a Venezuelan gold mine opened in 1871, was for a time one of the richest gold mines in the world. US engineers became involved through the Rothschilds, who hired Hamilton Smith, whom Baron Edmond de Rothschild had met at the North Bloomfield in 1874, to report on the property.[25] Smith "came in such close touch with the local owners in Venezuela that he was made consulting engineer," and promptly hired New Almaden and North Bloomfield veteran Henry C. Perkins to manage it, assisted by Thomas Mein as mine-captain. Mechanical engineers Louis Seymour assisted Perkins in operating the 60-stamp mill that crushed the extracted ore.[26] Perkins himself later recalled that "In Venezuela we employed chiefly negroes from the West India Islands, there being practically no local supply of labor." Though these men only had experience in agriculture, Perkins nevertheless thought them capable of improvement, becoming "expert in nearly all kinds of mining labor." Along with organizational improvements, Perkins boasted, even paid at three dollars per day, "with these men we produced and reduced the ore from the gold veins nearly as cheaply per ton as they did at that time at the Mysore mines, in India, where the laborers received only some 20 cents per day."[27] The important lesson that US and British mining engineers took away was that they could lower working costs by importing labor, in his case, from the Caribbean, mostly from Trinidad and Dominica.[28] This

[25] Rickard, *Interviews with Mining Engineers*, 414. For more on this connection, see Robert Vicat Turrell and Jean-Jacques van Helten, "The Rothschilds, The Exploration Company and Mining Finance," *Business History* 28, no. 2 (April 1986): 181–205.
[26] Rickard, *Interviews with Mining Engineers*, 229.
[27] Rickard, *Interviews with Mining Engineers*, 416. On mine labor at Mysore, see Janaki Nair, "Dangerous Labour: Crime, Work and Punishment in Kolar Gold Fields, 1890-1946," *Studies in History* 13, no. 1 (1997): 19–61.
[28] Robert A. Myers, "Post-Emancipation Migrations and Population Change in Dominica: 1834–1950," *Revista/Review Interamericana* 11, no. 1 (1981): 91.

was a lesson learned despite the fact that allowing African-descended workers to arrive was very unpopular with Venezuelan elites.[29]

The discovery of the De Beers diamond mine at Kimberley in 1871 is commonly understood to have touched off southern Africa's mineral revolution. Kimberley not only provided the beginnings of Cecil Rhodes' fortune, bankrolling his imperialist aims, but provided the capital and expertise to extract the Rand's ore. As early as 1888 Rhodes fantasized that De Beers had "every chance" of becoming "another East India Company."[30] As Rob Turrell has suggested, that knowledge extended to the closed compound system created at Kimberley in the mid-1880s as mining shifted from open to underground. Compounds functioned as "an early model of labour control for an industrializing South Africa," extending the period of time migrant African laborers stayed and built up their skill while simultaneously preventing the formation of an organized working class in town.[31] This notoriously deadly and oppressive system was quickly exported to the Rand and southern Rhodesia.[32]

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[29] Despite much searching, I have been unable to trace the history of these migrant workers after they moved to Venezuela. Winthrop R. Wright, "Race, Nationality, and Immigration in Venezuelan Thought, 1890 to 1937," *Canadian Review of Studies in Nationalism*, 6, no. 1 (1979), 4.

[30] Cecil Rhodes, "Letter to Lord Rothschild," October 29, 1888, MS402, Brenthurst Library, Johannesburg.

[31] Rob Turrell, "Kimberley's Model Compounds," *Journal of African History* 25, no. 01 (1984): 59–75.

[32] Kimberley has not been the subject of much recent attention from historians despite a number of excellent studies dating from the 1980s. See especially Rob Turrell, "Rhodes, de Beers, and Monopoly," *Journal of Imperial and Commonwealth History* 10, no. 3 (May 1982), 311–43; Robert Vicat Turrell, *Capital and Labour on the Kimberley Diamond Fields, 1871-1890* (Cambridge: Cambridge University Press, 1987); William H. Worger, *South Africa's City of Diamonds: Mine Workers and Monopoly Capitalism in Kimberley, 1867-1895* (New Haven, CT: Yale University Press, 1987); Colin Newbury, *The Diamond Ring: Business, Politics, and Precious Stones in South Africa, 1867-1947* (Oxford: Clarendon Press, 1989); Stefan Kanfer, *The Last Empire: De Beers, Diamonds, and the World* (New York: Farrar, Straus and Giroux, 1993). The authoritative biography of Rhodes remains Robert I. Rotberg, *The Founder: Cecil Rhodes and the Pursuit of Power* (New York: Oxford University Press, 1988). An excellent comparative analysis of labor in Kimberley and Birmingham, Alabama coal mining is William H. Worger, "Convict Labour, Industrialists and the State in the US South and South Africa, 1870–1930," *Journal of Southern African Studies* 30, no. 1 (March 2004): 63–86. On southern Rhodesia's connection to the Rand, see the aforementioned Turrell, "Kimberley's Model Compounds." More general works include Giovanni Arrighi "Labour Supplies in Historical Perspective: A Study of the Proletarianization of the African Peasantry in Rhodesia," *Journal of Development Studies* 6, 3 (1970), 197–234; Charles van Onselen, *Chibaro: African Mine Labour in Southern*

When mining at Kimberly moved underground in the mid-1880s, however, it was a Saginaw, Michigan-born mining engineer, Gardner F. Williams, who connected Kimberley's "Big Hole" to the United States. Although born in Michigan, Williams grew up in California gold country, and trained in mining engineering first at the University of California and then at Freiberg's *Bergakademie*. Williams arrived in South Africa in 1884, first surveying the area in a consulting role for the Rothschilds but was soon working for Rhodes,[33] and was appointed as general manager of De Beers in 1887, a position he held until 1905.[34] Williams was a significant node in the global network of mining engineers, and he more than any other is responsible for the influx of US mining engineers to South Africa in the late 1880s and 1890s, including his son, Alpheus Williams, who took over as manager upon his father's retirement. Williams connected Rhodes and the Randlords more generally with US mining engineers, beginning with Edmund G. de Crano and Hamilton Smith.[35] De Crano advised Nathaniel Rothschild to finance Rhodes' consolidation plan, writing in 1887 that he had "visited all the workings of De Beers and Central and have a high opinion of these properties. The supply of 'blue' seems most unlimiting in both mines—but I think that De Beers has the most 'insight.'"[36] Williams also became chairman of the School of Mines in Kimberley upon its establishment in 1896, holding the position until it

Rhodesia, 1900-1933 (London: Pluto, 1976); Ian Phimister, *Wangi Kolia: Coal, Capital and Labour in Colonial Zimbabwe 1894-1954* (Harare: Baobab Books, 1995); Tapiwa Madimu, "Farmers, Miners and the State in Colonial Zimbabwe (Southern Rhodesia), c. 1895-1961" (PhD Dissertation, Stellenbosch University, 2017).

[33] Williams, *Some Dreams Come True*, 510; Rotberg, *The Founder*, 196. Robert Turrell says this was on the advice of Hamilton Smith. See Turrell, *Capital and Labour*, 216.

[34] Williams, *Diamond Mines of South Africa*; T. A. Rickard, "Gardner F. Williams, An Appreciation," *Engineering and Mining Journal-Press* 114, no. 13 (September 23, 1922): 532–33. While Williams' *Diamond Mines of South Africa* is one of the most important accounts of diamond mining and remains a reference volume on diamonds, Williams does not seem to have left any papers.

[35] Cecil Rhodes, "Letter to Lord Rothschild," October 29, 1888, MS402, Brenthurst Library, Johannesburg.

[36] E. G. de Crano to NMR & Sons, 28 November 1887, RAL T43/15. Photocopied version at Brenthurst Library, Johannesburg.

was transferred to Johannesburg in 1903.[37] Williams was thus well-placed to disseminate his views on race management to the engineering and managing class.

Williams' hire was well timed, as De Beers underwent significant changes and faced numerous crises in the mid-to-late 1880s. Kimberley's diamond mining industry was in "deep crisis" in 1885, owing to falling prices and intense competition between mine owners.[38] While as early as 1882 Rhodes planned to increase profitability by mining at greater depths, plans for consolidation materialized in 1887.[39] This marked the beginning of Rhodes' horizontal monopolization of Kimberley's diamond mines, achieved through a process of amalgamation, requiring a tremendous capital raise. Through his connections in London, Williams may have had a role in suggesting amalgamation and connecting Rhodes to the Rothschilds for the purpose of raising capital.[40] More significantly, along with 220 human souls—over 80 percent of the dead were Africans—the De Beers mine itself was devastated in a fire on July 11, 1888, that destroyed the underground workings.[41] Williams was on site at the time the fire broke out. Barney Barnato later commended Williams for "working night and day, and doing all he possibly could for the relief of the sufferers," and saying that "no person can attach the least blame" to Williams for causing the fire.[42] Williams himself deflected blame in a predictably racialized way, identifying the likely cause of the blaze as "one of the native miners," who had snuck off and "placed a lighted candle so carelessly that the flame ignited the timbers, perhaps while the lazy

[37] Williams, *Some Dreams Come True*, 236.
[38] Worger, *South Africa's City of Diamonds*, 191.
[39] William Beinart and Saul Dubow, *The Scientific Imagination in South Africa: 1700 to the Present* (Cambridge: Cambridge University Press, 2021), 129.
[40] Colin Newbury, "Technology, Capital, and Consolidation: The Performance of De Beers Mining Company Limited, 1880–1889," *Business History Review* 61, no. 1 (1987), 29–30.
[41] Williams, *Diamond Mines of South Africa*, 387–400.
[42] Williams, *Diamond Mines of South Africa*, 399.

savage was snoring on the floor." Williams offered no evidence for such a claim beyond his own prejudice, allowing that the fire's "precise cause" was "never determined."[43] Although 465 men working below the fire managed to escape to safety, Williams separated out the 220 victims by race: "Forty-two white men and 178 natives lost their lives in levels and passageways charged with deadly smoke." In all, the fire caused three months of lost production time, and Barnato estimated the true loss at £250000.[44] However, the newly amalgamated corporate structure and rebuilding offered Williams the opportunity to implement widespread changes: "The assured control of all the mines and their operation by De Beers Consolidated Mines Limited enabled its directors to institute and conduct successfully a single broadly comprehensive plan for extracting the diamond-bearing rock and for disposing to the best advantage the total product of their mines," he wrote. This new systematic mining "was devised and applied by me shortly after my appointment as general manager of the De Beers Consolidated Mines Limited, and was based essentially on a method suggested by the miners themselves and without reference to any other system."[45] The new method involved widening tunnels, increasing mechanization through improved winding machines and self-dumping skips, and electrification to prevent future fires.[46] A visit by a "distinguished French engineer," M. E. Boutan, in 1888, confirmed the superlative nature of Williams' engineering abilities. Boutan remarked to Kimberley diamond magnate Paul Dreyfus that "he had not yet seen a diamond mine better

[43] Williams, *Diamond Mines of South Africa*, 389.
[44] Williams, *Diamond Mines of South Africa*, 399.
[45] Williams, *Diamond Mines of South Africa*, 314–15. Williams describes the new "systematic mining" in detail over pages 307–59.
[46] Worger, *South Africa's City of Diamonds*, 248–53.

worked than De Beers Mines."[47] Importantly, this new system included teaching mining skills to "natives fresh from the kraals," who soon have "nearly as much skill as most European miners."[48] The practice that Williams inaugurated in Kimberley of imparting skills to non-white workers was an important bridge between similar post-emancipation labor practices in the US south and a pattern that as we will see would in a few years be repeated on the gold mines of the Rand.

Williams' account evinces no awareness of the colonial warfare and deprivation that forced so many Africans to Kimberley, although he did describe some who had traveled over 1000 miles to Kimberley looking like "living skeletons."[49] Approximately two thirds of Kimberley's workers were Bapedi and Tsonga men who were increasingly coerced into migratory wage labor because of ecological decline, colonial hut taxes, and colonial warfare.[50] Peter Delius has shown how Bapedi often sought migrant labor to purchase rifles to deal with threats from colonists, Zulu, and Swazis.[51] Williams's appointment as general manager coincided with a "watershed" in labor contracting patterns in Kimberley, when in 1885 and 1886 the three biggest companies stopped contracting those who had traveled independently to the diamond fields and employed only those they had recruited.[52] By 1889, under Williams' management, all African workers were housed in compounds.[53]

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[47] Paul Dreyfus to NMR and Sons, 19 November 1888, RAL T43/24. Photocopied version in Brenthurst Library, Johannesburg.
[48] Williams, *Diamond Mines of South Africa*, 326.
[49] Williams, *Diamond Mines of South Africa*, 413.
[50] Worger, *South Africa's City of Diamonds*, 64–109. On Bapedi and migrant labor, see Peter Delius, *The Land Belongs To Us: The Pedi Polity, the Boers and the British in the Nineteenth-century Transvaal* (Berkeley: University of California Press, 1984), 62–82.
[51] Delius, *Land Belongs To Us*.
[52] Worger, *South Africa's City of Diamonds*, 107.
[53] Turrell, *Capital and Labour*, 158; Williams, *Diamond Mines of South Africa*, 413–20.

Williams' own description of mine workers is an astonishing and revealing account of continental and global labor migration, with a variety of racial, ethnic, national origin possibly without parallel in the 1880s. Williams describes the diggers who arrived as part of the early rush in the 1870s as largely of "of English descent, but many were Dutch, and hardly a nation in Europe was unrepresented." More surprisingly, Williams also writes of this period, "Black grandsons of Guinea coast slaves and natives of every dusky shade streaked the show of white faces."[54] As he put it elsewhere, "Europe, Asia, Africa, and America had boiled over into a hotch-potch, splashed on a diamond bed in the heart of South Africa."[55] Williams's description of the assemblage of workers on and in the mines bears repeating in full:

> Nowhere on the face of the earth is there an assemblage of workers of such varied types of race, nationality, and coloring as are to be seen in the South African Diamond Fields. There is hardly a nation of Europe or Colony of the British Empire that has not some representatives. There are adventurers from the United States, Mexico, and South America; and white from all the Colonies of South Africa mingle with the masses of native Africans of every shade of dusky hue shown by the tribes that range from the Cape to the equator. Even the American Indian is not unknown in the fields, one specimen at least having resided there for many years. Add to this motley throng a sprinkling of dark East Indians, Malays, and Chinese, and the kaleidoscopic shifts and coloring of this babel in the Diamond Fields may be dimly conceived.[56]

Still, when mining was increasingly capitalized, industrialized, and underground, just one sixth of workers were white, and most of those were "employed above ground on the floors, in the

[54] Williams, *Diamond Mines of South Africa*, 127. It is unclear if Williams is referring to enslaved people from the Guinea Coast forcibly moved to the Cape Colony, as he describes on page 88, or more generally through the trans-Atlantic slave trade. On Guinea Coast slavery, see Paul E. Lovejoy, "The Upper Guinea Coast and The Trans-Atlantic Slave Trade Database," *African Economic History* 38 (2010): 1–27. On slavery at the Cape, see Robert Carl-Heinz Shell, *Children of Bondage: A Social History of the Slave Society at the Cape of Good Hope, 1652–1838* (Hanover, NH: University Press of New England, 1994); Wayne Dooling, *Slavery, Emancipation and Colonial Rule in South Africa* (Scottsville: University of KwaZulu-Natal Press, 2007).
[55] Williams, *Diamond Mines of South Africa*, 189.
[56] Williams, *Diamond Mines of South Africa*, 407.

workshops, and in the offices of the mining companies."[57] What stands out in Williams's account, besides the sheer variety and geographic range of workers, is what he calls the "marked tribal distinctions" he saw existing between various groups of African workers.[58] Believing deeply in his own whiteness, Williams thought that each group looked "up on the manager as their great white chief" but were also "innately clannish."[59] Of the 11,000 Africans who worked for De Beers, Williams had clear favorites: "the Zulu, sprung from the warlike tribes moulded by Chaka, is one of the best of the native workmen;" "Amashangaans, coming chiefly from Portuguese East Africa," who he thought "closely akin" to Zulus; and "Transvaal Basutos" who "form the most obedient class of native laborers" and could learn to become skilled drillers.[60] Williams focused on the physical characteristics of "tribes," listing their heights and imputing meaning to it. For instance, he described "Batlapins from Bechuanaland" (Batlhapings, a Batswana group) as exceptionally short in stature, and noted they were "not favorites at the mines with other tribes, or with the whites," because they were seen as "impudent and meanly selfish," as well as "difficult to instruct in underground work."[61] This highly divided workforce evidently worked well as a method to control and discipline. Only once was there a "threat of a serious insurrection in the compound," which demonstrates how race management could work in practice. One year on Christmas Eve, when the compound manager was away for the holiday, several hundred Amafengu workers refused to go underground.

[57] Williams, *Diamond Mines of South Africa*, 407.
[58] Williams, *Diamond Mines of South Africa*, 424.
[59] Williams, *Diamond Mines of South Africa*, 416.
[60] Williams, *Diamond Mines of South Africa*, 425.
[61] Williams, *Diamond Mines of South Africa*, 426. For more on the Batlhaping, see Kevin Shillington, *The Colonisation of the Southern Tswana, 1870–1900* (Braamfontein: Ravan Press, 1985); Kevin Shillington, *Luka Jantjie: Resistance Hero of the South African Frontier* (Johannesburg: Wits University Press, 2011).

When Williams's confrontation with the leaders was unsuccessful, one of his "obedient" groups, the Basotho, "were willing to support me, and offered to drive the reluctant Fingos, or Amafengu, underground."[62]

While Williams did not invent the racial division that already characterized diamond mining during Kimberley's first fifteen years, he did much to advance and crystallize it.[63] As De Beers took final shape in the five years following the fire, Williams was at the fore, and by "1890-91 racial noncooperation and violence became the order of the day in the workplace."[64] By then, less than 500km away, industrialized gold mining on the Rand was underway.

The Rand, 1889-1901

Just three years after gold was discovered at in 1886 at the Langlaagte farm in what is now Johannesburg, South Africa, touching off the Witwatersrand gold rush, the rush came to a rapid halt due to what historian Charles van Onselen described as a "technological disaster." Miners quickly discovered that below 35 meters, the vast quantities of gold were "locked into the conglomerate by pyrite crystals," and a technological disaster became a financial one in turn.[65] It was in this context that Jennings arrived in Johannesburg in 1889 in the employ of H. Eckstein & Co., a London-based mining firm. Jennings' engineering achievements were so apparent that in another three years, in 1892, Jennings was elected first president of the South African Association of Engineers and Architects. In his inaugural address, Jennings outlined his

[62] Williams, *Diamond Mines of South Africa*, 442. On Basotho migrant labor, see Eddy Tshidiso Maloka, *Basotho and the Mines: A Social History of Labour Migrancy in Lesotho and South Africa, c. 1890-1940* (Dakar: Codesria, 2004).
[63] Worger, *South Africa's City of Diamonds*, 110–187.
[64] Worger, *South Africa's City of Diamonds*, 237, 268.
[65] Charles van Onselen, *Studies in the Social and Economic History of the Witwatersrand, 1886-1914, Volume 1: New Babylon* (New York: Longman, 1982), 6.

vision of the task that lay ahead of them, one that he believed far more pressing than scientific research: “Almost all of us are so busy making history that we cannot have time to write it too; we are not men of leisure.” More important to Jennings was the task of developing a “vast country of whose mineral wealth indications are everywhere present,” and furthering mineral extraction which he saw as the “most potent pioneer in the development of a new country, and an enormous stimulus to colonization.”[66] In other words, Jennings explicitly yoked mineral extraction to the settler colonial project. Soon, these men began holding their meetings at the Chamber of Mines and partnered with the mining capitalists who employed them to forge a singular system of racial capitalism, albeit one drawn up with distinctly US blueprints. By 1902, in the aftermath of the South African War of 1899-1902 and the British imperial takeover of the goldfields, as seen in the following chapter, it was Jennings who Lord Milner, Governor of the Transvaal and Orange River Colony, turned to for advice on recruiting a sufficiently large and inexpensive labor force to mine the gold, arguably the central task facing Milner and the Randlords.[67] Jennings and his coterie of fellow US mining engineers had a free hand to engineer not only mining works but a whole social system, one that in many ways persists to this day.

Nearly two generations now of South African historiography are clear in demonstrating how the way the “problem” of mine labor—that is, the question of where would mine workers be sourced and how would they be compelled or coerced to labor—was solved had lasting consequences, dire ones not only for South Africa’s African population, but for mineworkers

[66] Hennen Jennings Address, *Proceedings of the South African Association of Engineers and Architects*, 1892.
[67] On the Randlords, see Geoffrey Wheatcroft, *The Randlords: The Men Who Made South Africa* (London: Weidenfeld & Nicolson, 1985).

and their families from across southern and central Africa.[68] What this formidable historiography misses, however, is how Jennings and a group of fellow mining engineers combined their training in the US academy with practical experience in race management in the US West and beyond, to assume a decisively influential role in Transvaal politics, culture, and eventually in the circle of pro-imperial policymakers and intellectuals that surrounded Lord Milner. South African historiography generally accepts it as a given that the low-grade ore meant that the mines would inevitably seek a "cheap labor" solution involving migrant African men. While this is, in fact, the end result, this chapter and the one that follow seek to challenge this apparent inevitability and understand the process by which South Africa ended up with such a system.[69]

Hennen Jennings arrived in Johannesburg at the beginning of an economic slump in gold mining as part of a cohort of about seventy-five US mining engineers employed on the Rand. These engineers were themselves just one component of about 1500 US citizens by the eve of the South African War living in the Transvaal.[70] By the middle of the decade, US mining engineers had come to manage over half of the gold mines of the Rand.

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[68] The radical challenge to liberal South Africanist historiography arguably began with H. J. Simons and R. E. Simons, *Class and Colour in South Africa, 1850-1950* (Harmondsworth, UK: Penguin, 1969), followed by Harold Wolpe, "Capitalism and Cheap Labour-Power in South Africa: From Segregation to Apartheid," *Economy and Society* 1, no. 4 (November 1972): 425–56; Martin Legassick, "South Africa: Capital Accumulation and Violence," *Economy and Society* 3, no. 3 (August 1974): 253–91; Frederick A. Johnstone, *Class, Race, and Gold: A Study of Class Relations and Racial Discrimination in South Africa* (London: Routledge, 1976). For an overview, see Christopher Saunders, *The Making of the South African Past: Major Historians on Race and Class* (Cape Town: David Philip, 1988), esp. 165–85.

[69] For one example, see Alan H. Jeeves, *Migrant Labour in South Africa's Mining Economy: The Struggle for the Gold Mines' Labour Supply, 1890-1920* (Kingston: McGill-Queen's University Press, 1985), 6.

[70] Alpheus F. Williams, *American Engineers in South Africa*, 1902; Stephen Tuffnell, "Engineering Inter-Imperialism: American Miners and the Transformation of Global Mining, 1871–1910," *Journal of Global History* 10, no. 01 (March 2015), 59.

While Gardner Williams had opened the flow of US engineers as manager for the De Beers diamond mine in Kimberley, the economic incentives for gold mining, which began after diamond mining, had changed the calculus considerably: where the way to profit from diamond mining had been to control the market for diamonds, in the case of gold the only route was to ruthlessly and relentlessly control costs.[71] This was especially true in the case of deep level mining, as the English engineer E. J. Way pointed out without calling attention to race: "This labour question is the question where low grade mines are concerned."[72] It would also be the central question the mine owners asked the US engineers to solve.

Before that, however, US engineers took the lead in physical engineering of the mines, lending them a degree of credibility when they later turned to labor. One of the first innovations came from Jennings: as one US journalist visiting the Rand in 1895 wrote, by conceiving "the idea of sinking a long shaft at a distance from the main reef," Jennings allowed for the "beginning of the 'deep level' workings," from which "many of the richest mines have been and are being developed."[73] The most important of these developments, though, was the cyanide process, where cyanide is used to extract gold from the crushed ore, which on the Witwatersrand had a relatively low gold content. While the process had been invented in Scotland, its widespread use in the Transvaal was fostered by Jennings, who quickly arranged for his former colleague from the New Almaden quicksilver mine, University of California graduate Charles Butters, to supervise the process. By 1898, the Rand led the mines of the

[71] Geoffrey Wheatcroft, *The Randlords* (London: Weidenfeld & Nicolson, 1985), 121.
[72] Edward J. Way, "Letter from Edward J. Way to George Heys," January 11, 1892, MS.727/L5, Brenthurst Library, Johannesburg, South Africa. Emphasis in original.
[73] Carl Snyder, "South Africa's Gold," *Portland Oregonian*, July 14, 1895.

world in the lowest cyanide costs.[74] Along with innovations in plant electrification, geologic knowledge and skill at sinking deep shafts—essential to the increasingly deep levels mining commenced at as outcrop mines wore out—were likewise indispensable.[75] Acting for the United States Geological Survey (rather than for British investors, as was the case with almost every US mining engineer on the Rand), was another alumnus of the New Almaden George Ferdinand Becker. Becker's 1896 survey and estimates of the gold capacity of the Rand played a significant role in convincing investors of the profitability of deep level mining and of the long term returns of exploiting the Rand.[76] Indeed, Becker's estimate that the Rand would continue to be payable for many years continued to be referenced well into the 1900s.

While it is impossible to quantify precisely how much more profit and dividends US engineers managed to wring out of the earth and those laboring on and in it, one American engineer, Harry H. Webb, made the attempt upon Jennings' farewell dinner in 1903. In a eugenical turn of phrase, Webb described Jennings the "highest type" of the "American mining engineer," and noted that the total output of gold from the Rand in the three years before Jennings' arrival was 642000 ounces. On the eve of the South African War, in the month of August 1899 alone, output was 460,000 ounces—roughly twenty-five times what it had been a decade before the Yankees began pouring in.[77] Indeed, barely more than a month into

[74] John Yates, *Present Day Metallurgical Engineering on the Rand* (London: The Mining Journal, 1898), 106.
[75] H. H. Webb, "Rapid Work in Shaft Sinking," *Engineering and Mining Journal*, May 22, 1897, 507.
[76] George F. Becker, "Witwatersrand Banket, with Notes on Other Gold-Bearing Pudding Stones," in *Eighteenth Annual Report of the United States Geological Survey, Part V*, 1897, 153–84. In his role for the US government in administering the Phillippines, it is tempting to believe that his survey of the capacities of different races in the Phillippines were derived from his South African experience. See Hendrickson, "Advance Agent of Expanding Empires;" Black, *Global Interior*, 43–44.
[77] "Farewell Dinner to Mr. J. Hennen Jennings," *Proceedings of the South African Association of Engineers* 8 (May 16, 1903): 161–68.

Jennings' time on the Witwatersrand, mine magnate Lionel Phillips was already writing to his partners Julius Wernher and Alfred Beit in London to make moves based on Jennings' advice. Phillips wrote that the firm needed to move into deep level mining—which was in fact the long-term future of mining on the Rand—and cited Jennings as the authority on the matter.[78] A few weeks later, Jennings was already putting his experience in the United States to work, complaining to Phillips about the inefficiency of surface sorting and crushing, which had been done far more cost effectively in the Black Hills of South Dakota.[79] Two years later, when Jennings contemplated switching firms, Phillips wrote in a panic to Eckstein that this must not be allowed to happen. If neither Jennings or another American, Henry Perkins, were available, he wrote, "I *must have* a high class man and *soon*."[80] Later in life Phillips recalled how fortunate he was when, having been on the Rand only three months after beginning his fortune in diamonds in Kimberley and being generally clueless about the situation, that his staff was strengthened by the arrival of Jennings, "an American engineer of eminence" who had "high moral principles and used meticulous care in securing and marshalling facts."[81] Phillips would continue to lean on Jennings' skills in these areas.

Whatever the height of their technical and managerial skills, the return engineering methods could bring to mining capitalists in London was going to be limited as long as the world's largest gold deposit continued to be under earth claimed as sovereign by the South African Republic. The story of the conflict between chiefly British mining capital, backed by the

[78] Letter from Lionel Phillips to Wernher, Beit, January 3, 1890, Maryna Fraser and Alan Jeeves, eds., *All That Glittered: Selected Correspondence of Lionel Phillips, 1890-1924* (Cape Town: Oxford University Press, 1977), 34.
[79] Letter from Phillips to Wernher, Beit, January 30, 1890, *All That Glittered*, 36.
[80] Letter from Phillips to Eckstein, December 17, 1892, *All That Glittered*, 66. Emphasis in original.
[81] Lionel Phillips, *Some Reminiscences* (London: Hutchinson, 1924), 114.

British Empire, against the Afrikaner republic, has been ably told elsewhere. As fellow republicans, US engineers and the US public at large tended to have more sympathy than British uitlanders on the Rand, but ultimately the engineers' belief in progress, development, and free market capitalism caused them to side with the ones who were after all paying their handsome salaries.

The issue of how best to open up the goldfields to uninterrupted capitalist development cleaved the community of US mining engineers in two. The first and most dramatic route has been the one that has gained the most attention from the US public and historians ever since. John Hays Hammond's friendship with Cecil Rhodes, the fact that he commanded the highest salary of any engineer on the Rand,[82] and his involvement in the Jameson Raid was what made his name. It also meant that Hammond—who figures prominently in evidence historians marshal to demonstrate US engagement on the Rand—was effectively banished from the Rand on the eve of its most important pivot.[83]

While Hammond was away planning a revolution with Rhodes and proposing raising the Stars and Stripes over the Transvaal, engineers like Jennings and Perkins were more willing to work within the confines of the SAR. In one account, Perkins "is said barely to have raised his head from his calculations to hear the news of the Jameson Raid and then only to have

[82] Hammond claims in his autobiography that Barney Barnato said as much to him, and Clark Spence uncritically relies on Hammond's claim to make the same point. At least before the Jameson Raid made him a minor celebrity, in 1895 Hammond and Jennings each earned a salary of £10,000. Spence, *Mining Engineers and the American West*, 136–137; Carl Snyder, "South Africa's Gold," *Portland Oregonian*, July 14, 1895; Hammond, *Autobiography*, 1:200–201, 2:502–3.

[83] Enid de Waal, "The Part Played by the Americans on the Witwatersrand During the Period 1886-1899" (MA thesis, University of South Africa, 1971). A notable exception that considers Hammond's work before and after his time in South Africa is Hendrickson, "'The Sesame That Opens The Door of Trade.'"

muttered something about ""bloody fools who take part in politics."[84] The story captures the conservative, calculating personalities of the two "Corner House" (Wernher Beit) engineers, noting that while the Jameson Raid halved share prices, it did nothing to stop the important work of sinking ever more shafts. Contrary to the account of their aloofness, Jennings and Perkins were in fact actively lobbying to prevent the chaos they felt would ensue from a southern-style filibuster on the Rand. The prospect of that kind of chaos may have provoked fear of the image of orderly whiteness becoming undone. The two engineers traveled north to Pretoria to meet President Kruger and alert him on the impending Uitlander revolution, setting in motion "a series of political manoeuvers to sideline Hammond and subvert the coming 'revolution'. From then on Cowboy Jack [Hammond]'s position as the American revolutionary leader unravelled."[85] The failure of the Raid and Hammond's subsequent imprisonment in a Pretoria jail touched off a nationwide lobbying campaign among elite Americans for his release, as discussed in chapter 2. The campaign also fostered a new awareness of, and diplomatic ties to, the Transvaal and southern African more generally in the United States.[86] While the Jameson Raid continues to figure largely as an example of naked and aggressive imperialist greed, and owing to the so-called Blainey Thesis, is well-known to mining historians, US engineers like Perkins who were more interested in *engineering* (whether that be material or social, or of rocks or people) than political intrigue, would do far more to shape the coming racial order in southern Africa.[87]

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[84] A. P. Cartwright, *The Corner House: The Early History of Johannesburg* (Cape Town: Purnell & Sons, 1965), 161.
[85] Van Onselen, *Cowboy Capitalist*, 137, 194.
[86] C. Tsehloane Keto, "The Aftermath of the Jameson Raid and American Decision Making in Foreign Affairs, 1896," *Transactions of the American Philosophical Society* 70, no. 8 (1980): 1–46.
[87] G. Blainey, "Lost Causes of the Jameson Raid," *Economic History Review* 18, no. 2 (1965): 350–66. Blainey argued that support for the Raid was divided between owners of deep level mines and outcrop mines, the latter being

In the aftermath of the Jameson Raid, and in the context of a shrinking market for gold shares that began in September 1895 but was only exacerbated by the Raid, the ZAR did take steps to reorganize and foster the mining industry, partly to fend off conflict with the British and partly for their own ends.[88] Still, a number of sticking points remained, chief among them the supply and management of African labor; the government's dynamite monopoly; and the railroad concession. Hammond himself wrote in early 1897 that while he considered South Africa's physical prospects promising, the "labor problem" would not be resolved until all of South Africa's provinces were unified and the British-Afrikaner divide bridged.[89] In retrospect, the most important maneuver Kruger made to stem conflict was the 1897 Industrial Commission, intended merely to provide the appearance that the ZAR was considering the needs of the mining industry. Kruger appointed "one of the most influential of Afrikaner leaders" Schalk Burger as Chairman and five other members of the Volksraad to the Commission, which duly invited witness testimony.[90] The evidence of mining experts was damning of Kruger's government, who was livid with Burger for allowing the truth to emerge and "validating every complaint that the gold-mining industry had laid before the government

opposed. While influential, Blainey's deterministic schema has largely been discredited. See Elaine Katz, "Outcrop and Deep Level Mining in South Africa before the Anglo-Boer War: Re-Examining the Blainey Thesis," *Economic History Review,* 1995, 304–28.

[88] Robert V. Kubicek, "The Randlords in 1895: A Reassessment," *Journal of British Studies*, Vol. 11, No. 2 (May 1972), 84–103; Patrick Harries, "Capital, State, and Labour on the 19th Century Witwatersrand: A Reassessment," *South African Historical Journal* 18, no. 1 (November 1986): 25–45. Charles van Onselen makes a similar point in *New Babylon*, 13.

[89] John Hays Hammond, "South Africa and Its Future," *North American Review* 164, no. 483 (February 1897): 233–48. For an overview of the period following the Raid, see Alan Jeeves, "Aftermath of Rebellion—The Randlords and Kruger's Republic after the Jameson Raid," *South African Historical Journal* 10, no. 1 (November 1978): 102–16.

[90] Shula Marks and Stanley Trapido, "Lord Milner and the South African State," *History Workshop Journal* 8, (Autumn 1979), 61.

over many years."[91] The Witwatersrand Chamber of Mines, no doubt thrilled with their luck, compiled and published the evidence and report, which was in any case closely watched by observers and investors in at least the United Kingdom, France, and the United States.

Leaving aside the veracity of the criticisms launched at Kruger, historians have generally agreed that the testimony sketched a blueprint for British imperial rule of the Transvaal following the South African War.[92] The role of US mining engineers in general, and Corner House leading light Hennen Jennings, in setting that agenda was clearly impressed on contemporaries: the commissioners themselves noted that other witnesses seemed to be following Jennings' lead and relying on his calculations, while the correspondent for the London *Financial Times* enthusiastically parroted Jennings' conclusions, approving of the "enormous mass of statistical information" from the "eminent mining engineer. [93] Even Hammond wrote to Jennings to express his "high appreciation" for the "capable representation you have made to the government."[94] Jennings' testimony was reprinted in the London financial journal *South Africa*, as well as included as an appendix to *Present Day Metallurgical Engineering on the Rand*,

[91] John J. Stephens, *Fuelling the Empire: South Africa's Gold and the Road to War* (Chichester, UK: Wiley, 2003), 248–49.

[92] Marks and Trapido, "Lord Milner and the South African State"; Shula Marks, "Lord Milner and the South African State Reconsidered," in *Imperialism, the State, and the Third World*, 1992; Keith Breckenridge, *Biometric State: The Global Politics of Identification and Surveillance in South Africa, 1850 to the Present* (New York: Cambridge University Press, 2014). Breckenridge calls attention to how the demands of mine engineers for pass laws "became the distinguishing characteristic of the South African state." *Biometric State*, 73. Marks and Trapido focus on the testimony of Californian hydraulic engineer William Hammond Hall, neglecting the fact that Jennings led the charge. For a more general treatment of these issues, see A. Atmore and S. Marks, "The Imperial Factor in South Africa in the Nineteenth Century: Towards a Reassessment," *Journal of Imperial and Commonwealth History* 3, no. 1 (October 1974): 105–39. Stephen Tuffnell is one of only two historians to focus on the role of Jennings at the Commission. See Tuffnell, "Engineering Inter-Imperialism," 65-67. A briefer treatment can also be found in Morley Nkosi, *Black Workers, White Supervisors: The Origins of the Labor Structure in South Africa* (Trenton, NJ: Africa World Press, 2017), 137–40.

[93] "The Transvaal Mines Commission," *Financial Times* (London), June 8, 1897.

[94] John Hays Hammond to Hennen Jennings, 16 June 1897, Private Letter Book 3, Manuscripts and Archives, Sterling Memorial Library, Yale University.

published by the London *Mining Journal* with the rather accurate title, "Economics of the Transvaal Gold Mining Industry."[95] To those with capital at stake in the mines of the Rand, what Jennings had to say was important.

The presence of engineers at the Commission would have been hard to miss: of thirty-three witnesses who gave testimony between late April and early June, 1897, fully a third were engineers, most specializing in mining, while some working in allied fields like mechanical engineering. Of those, six were from the United States, included Jennings, his younger brother Sidney, Louis Seymour, Thomas Leggett, William Hammond Hall, and Robert Mayo Catlin.[96] Another, George Denny, was Australian but had extensive professional experience in the United States, Canada, and elsewhere. The remainder were British, but even one, Edward J. Way, had been assistant to John Hays Hammond previously.

Of the thirty-three witnesses, Jennings' testimony was the longest, taking place over three days and running to forty-six pages of printed text. Before that, however, his younger brother Sidney Jennings, who had been in South Africa as general manager of the Crown Reef Gold Mining Company for just less than a year, laid out some of the basic demands that would be repeated. Sidney Jennings testified that profitable gold mining suffered from an excessively high cost of coal and dynamite under the ZAR's concession policy, and called for lower native wages, which he believed could be had if the current laws restricting the sale of alcohol to black mineworkers and pass laws to prevent absenteeism, were properly enforced. If African workers

[95] John Yates, *Present Day Metallurgical Engineering on the Rand* (London: The Mining Journal, 1898).
[96] Catlin was born in Burlington, Vermont and active in Nevada before moving to Johannesburg. See "Robert Mayo Catlin, Mine Engineer, Dead," *New York Times*, November 24, 1934. Also see Tuffnell, "Engineering Inter-Imperialism," 64–67.

were prevented from drinking and absconding, the younger Jennings testified, they could be taught to do the "lower forms of work that are now done by white men," encouraging more mine development and white immigration. This boost to the settler state, he believed, "would be a permanent benefit to the country in many directions."[97]

Robert Catlin similarly had not been long in South Africa, but Catlin nevertheless had many suggestions and opinions. His primary point to the commission was a defense of the bonus system, whereby African miners could be paid well above their usual wages if the pace of shaft sinking proceeded at a correspondingly high rate. Catlin demonstrated that even taking the largest bonus as an example, the cost of shaft sinking with the bonus system in place, expressed in pounds sterling per foot, was in fact, "by long odds, the cheapest system in vogue."[98] This was the kind of calculated rationality typical of the Americans on the Rand: "my object is to get the shafts down as rapidly, and at the cheapest possible cost; and I do not care whether I have to pay an ignorant man or an educated man. I believe I work for the interest of my shareholders, and on this system would gladly pay a man £200."[99] Louis Seymour, too, had been in Johannesburg less than a year after his arrival from Kimberley, but testified to the high cost of living for white miners in South Africa relative to wages compared to other parts of the English-speaking world, as well as the high cost of coal and railway freight.[100] These were small pieces of the puzzle, however, compared to the grand designs Jennings had.

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[97] *Industrial Commission*, 44.
[98] *Industrial Commission,* 91.
[99] *Industrial Commission*, 92. Hammond boasted of a similar method devised by a recent University of California graduate he recruited to the Rand solve the shaft sinking problem with fresh eyes, which "soon established world records." Hammond, *Autobiography*, 1:300.
[100] *Industrial Commission*, 148–51.

More than any other witness, Jennings had done his homework and come prepared. As first president of the South African Association of Engineers and Architects, and as a long-time resident by Johannesburg settler standards, he was a well-known figure in white settler society. Jennings began his testimony by acknowledging his patrimony, reaching back to the engineers and geologists who he believed had laid the foundation for future prosperity. That began with his old mentor, fellow Kentuckian Hamilton Smith, who first pointed out the need for the best possible engineering and management available to be implemented on the Rand given the low amounts of gold contained in the reefs.[101] Smith estimated in 1893 that the Witwatersrand goldfields contained £325,000,000 worth of gold. Three years later, George Becker of the United States Geological Survey, more than doubled that estimate to £700,000,000, which would last for approximately ninety years. Jennings pointed out that this estimate was already out of date and was no doubt even higher in consideration of newly explored areas. Given this enormous resource, and never questioning that it needed to be extracted from the earth at great human cost, Jennings made numerous recommendations based on his experiences in Venezuela and the United States. In Venezuela, working costs had been reduced considerably by first improving machinery, which he said was already the best in the world on the Rand, and second, by "the encouragement of negro labour obtained by the West Indian Islands." At first, he said, these workers were of little use, but with training and experience, they were able to replace over ninety percent of white workers, although detective and police work to combat gold theft needed to be improved.[102] Jennings also used the example of the United States,

[101] For Smith's report, see Hamilton Smith, "The Witwatersrand Gold-Fields," *Times* (London), January 17, 1893. Also see White, "America's Greatest Gold-Mining Engineer," *Courier-Journal* (Louisville), August 30, 1908.
[102] *Industrial Commission*, 215, 223.

which comprised an enormous zone of free trade, as an example of what could be done by ending the concessions and encouraging free trade.[103] Jennings closed his opening statement by appealing to the patriotic pride of ZAR residents: “This country has now an opportunity in its history of showing its true greatness, by giving freely what could not be forced from it.”[104]

Initial reaction to the Commission by mining observers was overwhelmingly positive. In London, prices for South African mining companies rose swiftly. Jennings’ employer, Corner House, was impressed and delighted: Lionel Phillips remarked that “We all agree with, and are most favourably impressed with, the evidence” given by Hennen Jennings and J. P. FitzPatrick.[105] Lord Milner, too, was enthused and optimistic. In Pretoria, Burger wrote on behalf of the Commission in his capacity as chair to President Kruger, recommending without few exceptions all of the major points put forward by the American engineers. The commission found that, in fact, many mines were not paying dividends because of the high cost of production, and “entirely disapprove of the concessions through which the industrial prosperity of the country hampered. Such might have been expedient in the past, but the country has arrived at stage of development that will only admit of free competition according to Republican principles." Burger recommended measures to lower the cost of living for white workers; encouraging the growth of industries besides mining that could employ whites; and various measures to increase the supply of black labor, including an expansion of the area migrant laborers were drawn from, noting that “the chief supply must come from the East

[103] On the phenomenon of the imitation of the US capitalist model more broadly, see Sven Beckert, “American Danger: United States Empire, Eurafrica, and the Territorialization of Industrial Capitalism, 1870–1950,” *American Historical Review* 122, no. 4 (2017): 1137–70.
[104] *Industrial Commission*, 224.
[105] Lionel Phillips to J. P. FitzPatrick, June 12, 1897, Fraser and Jeeves, *All That Glittered: Selected Correspondence of Lionel Phillips, 1890-1924*, 105.

Coast (Portuguese territory)," as Hennen Jennings had recommended.[106] The Commission only stopped short of recommending African "locations" on the Rand. Burger had evidently been humbled by the mass of facts and statistics offered by experts at the Commission. He admitted that the ZAR was "still in its infancy" but had been presented a unique opportunity to learn from other countries "where these problems have for decades exercised the minds of their leading citizens." While Burger did not name the United States, he may as well have.[107] After all, it was the world's model for a unified domestic economy based on mineral resources, as well as coded white and male.[108]

However convincing the Commission was, Kruger was furious with Burger for essentially endorsing the criticism's leveled at the South African Republic. In turn, the Chamber of Mines was eincensed with Kruger, who refused to do much in the way of implementing their recommendations.[109] Jennings recalled later with characteristic understatement that although the Commission was "broad-minded and favorable to the mining industry, it was not thoroughly acted upon by the Government."[110] Mining stocks slumped, with the London correspondent for the *Engineering and Mining Journal* reporting that "There is no doubt that the hitch in the adoption of the Transvaal mining commission's recommendations is the cause

[106] For more on colonial Mozambique, see Eric Allina, *Slavery by Any Other Name: African Life under Company Rule in Colonial Mozambique* (Charlottesville: University of Virginia Press, 2012); Patrick Harries, *Work, Culture, and Identity: Migrant Laborers in Mozambique and South Africa, c. 1860-1930* (Portsmouth, NH: Heinemann, 1994); Leroy Vail and Landeg White, *Capitalism and Colonialism in Mozambique: A Study of Quelimane District* (Minneapolis: University of Minnesota Press, 1980).
[107] *Chamber of Mines of the South African Republic: Ninth Annual Report for the Year Ending 31st December, 1897* (Johannesburg: Argus Printing, 1898), 75–86.
[108] Gavin Wright, "The Origins of American Industrial Success, 1879–1940," *American Economic Review* 80, no. 4 (September 1990): 651–88.
[109] *Chamber of Mines of the South African Republic: Ninth Annual Report for the Year Ending 31st December, 1897*, 3.
[110] Rickard, *Interviews with Mining Engineers*, 248.

of this lull. Everyone supposed that the recommendations would be adopted at once, but now it appears that both the Raad and the government are putting difficulties in the way, and generally showing that they do not relish reforms."[111] White mine owners began to take matters into their own hands, reducing black wages by thirty percent, which marked the most significant cost reduction of 1897.[112] In his 1898 survey of Rand metallurgical practice, the English mining engineer John Yates remarked that "the time has arrived when our able Engineers and Managers can improve the workings of the mines but little further," and moreover, "unless the Government affords the much needed relief from present burdens, the brilliant future which as so often been predicted for these Fields will never be attained." This impression that it was governmental hindrance that caused the "prevailing depression on these Fields" led Yates to take the unusual step of including Jennings' 1897 testimony as an appendix to the book, noting that it "is a clear, reliable, and comprehensive review of the economics of Rand Mining, and will repay a careful study by all concerned."[113] Jennings' white extractivist views and comments, then, continued to guide mining industry demands.

Despite the pressure on Kruger for reforms, as Marks and Trapido have argued, Kruger understood he could not implement all of the reforms without giving away "his state."[114] Evidently knowing the desires of his voter base, Kruger was re-elected in 1898, prompting another round of calls for reform from the mining industry. Through his brother John Seymour in New York City, Louis Seymour—who later died in the war, as we have seen—attempted to

[111] "Mining Stocks," *Engineering and Mining Journal*, March 20, 1897, 295–96.
[112] *Chamber of Mines of the South African Republic: Ninth Annual Report for the Year Ending 31st December, 1897*, 5.
[113] John Yates, *Present Day Metallurgical Engineering on the Rand* (London: The Mining Journal, 1898), 11-12.
[114] Marks and Trapido, "Lord Milner and the South African State," 63.

convince President McKinley and Secretary of State Hay to back the British against Kruger, hoping that the additional pressure would cause Kruger to back down and accede to reform. Not having gained any traction on either end, Seymour's campaign was for naught, and in October 1899 war began.[115]

Postwar Reconstruction: War, Empire, Finance, and Chinese Labor, 1900-1903

As discussed in chapter two above, once war broke out, most everyone connected with gold mining fled the Transvaal. Notably, a group of 7000 Africans from Natal together walked nearly 250km over seven days to Newcastle. In the process they reinforced the growing sense of ethnic Zulu consciousness that had been growing on the Rand—divisions and ethnic consciousness sowed in part by mining engineers. This "new sense of unity," Michael Mahoney has shown, "centered around the legacy of the Zulu kings," and soon rumors of Dinuzulu's return to redeem Natal Africans began to circulate.[116]

It was after the war, however, that US mining engineers made a more lasting impact on the race and class dimensions of South African society. While Milner did not quite have a blank slate, during the period from the end of the war in 1902 up until his departure in 1905—and in some ways extending until 1907 and responsible government—the Transvaal was under the imprint of a "conquest" state, a state with the ability to intervene in civil society in ways that would not otherwise have been possible.[117] While some historians have noted in general terms

[115] John H. Ferguson, *American Diplomacy in the Boer War* (Philadelphia: University of Pennsylvania Press, 1939), 47-48. For more background on the lead up to the war, see Stanley Trapido, "Imperialism, Settler Identities and Colonial Capitalism: The Hundred Year Origins of the 1899 South African War," in *The Cambridge History of South Africa*, ed. Robert Ross, Anne Kelk Mager, and Bill Nasson (Cambridge: Cambridge University Press, 2011), 66–101.
[116] Michael R. Mahoney, *The Other Zulus: The Spread of Zulu Ethnicity in Colonial South Africa* (Durham, NC: Duke University Press, 2012), 145–49.
[117] Marks and Trapido, "Lord Milner and the South African State," 72–73; Deborah Lavin, *From Empire to International Commonwealth: A Biography of Lionel Curtis* (Oxford: Oxford University Press, 1995).

that the demands of US mining engineers in the 1890s shaped or foreshadowed subsequent developments, far less appreciated is how a number of them, along with other American colleagues, returned in the years after the war to advise the British imperial state how to efficiently mine gold and, in a completely related way, reorganize society along lines most conducive to that end. Central to this plan was once again Jennings, who found a far more receptive audience in Milner and the newly empowered mine magnates than Kruger. In that sense, the 1890s were merely prologue.

Having sketched out in the late 1890s a vision of a mine labor force reliant on a small number of white supervisors managing a predominantly black, migrant workforce, now that the Rand's gold was under British control, the path was laid to allow for making the Rand look more like the racially segmented labor force of the New Almaden mercury mine in California, or the El Callao in Venezuela. Unlike his older brother and most of the other US mining engineers who were more prominent, the younger of the two Sidney Jennings, remained in South Africa for at least some of the war. Writing to his employer, German-born British mine magnate Hermann Eckstein, Jennings sketched out a strategy for the postwar mining industry that was consistent with the demands engineers had made of the ZAR at the 1897 Industrial Commission. "When we get working," he wrote in October of 1900, "I anticipate that important reductions can be made in working expenses. The chief of which will be due 1st to Native Labor; 2nd to Coal; 3rd to dynamite; 4th to General Supplies." Jennings proposed a 40% reduction in wages to African workers compared to prewar rates, yielding a "reduction equivalent to 2/6 per ton [of ore] milled." African workers themselves, he noted, were "willing to work for the Boers for small wages" but expected a return to prewar wages upon British victory. This was of no concern to

Jennings: "This is a difficulty which will easily be surmounted under the firm rule of the military authority." Jennings at least appeared to have his finger on the pulse of the mine workforce and was able to enumerate precisely how his plan would reduce the all-important figure of working costs per ton, a calculus that in practice operated as a naturalized racist script. This sort of knowledge was invaluable to the imperialists and capitalists soon to transform Transvaal society.[118]

Once the war had ended, mine owners complained that the exigencies of war had inflated African wages, and not enough were showing up looking for work. As one, Henry Webber, correctly assessed, "The fate of the gold mining industry on which the prosperity of South Africa had been built was in the balance."[119] The Randlords turned once again to "Hennen Jennings, an American engineer of eminence," as another one of them, Lionel Phillips, described him. Four years after he had left for London in June 1898, Jennings returned to the Rand in the service of Wernher, Beit.[120] It did not take him long on the ground to write back to his employer in London and suggest that the Rand be worked by indentured Chinese laborers, leaving black South Africans to work the land. In doing so, Jennings drew upon a widespread post-emancipation practice of replacing newly emancipated and empowered black labor with indentured Chinese labor.[121] He may also have been abreast of Herbert Hoover's glowing reports the industry of Chinese workers from his experience in China. In 1899, Hoover wrote to his brother Theodore Hoover, another mining engineer, in untypically racist language that he

[118] Sidney Jennings to H. Eckstein, October 31, 1900, Volume 233, Archives of H. Eckstein & Co., Barlow Rand.
[119] H. O'Kelly Webber, *The Grip of Gold: A Life Story of a Dominion* (London: Hutchinson, 1936), 130–31.
[120] Lionel Phillips, *Some Reminiscences* (London: Hutchinson, 1924), 114.
[121] For an excellent treatment of this history in the US South, see Moon-Ho Jung, *Coolies and Cane: Race, Labor, and Sugar in the Age of Emancipation* (Baltimore: Johns Hopkins University Press, 2006).

would "break records in [working] costs here when we are started – for labor is only 10 cents per diem and superior men to Transvaal niggers."[122] In any event, Jennings and others drew on a range of sources to guide the decision to turn to indentured Chinese labor on the Rand.

British mining magnate George Farrar, head of East Rand Proprietary Mines, eventually took up the cause and became the loudest public voice pushing for Chinese labor importation, and eventually the one to introduce the bill for passage in the legislature.[123] On the 20th of August, the Chamber of Mines appointed to a private and confidential committee with the primary goal of querying their evaluation of different races and the suitability for gold mining. They wrote to thirteen engineers and mine managers asking for their experience managing black and Chinese labor in various contexts around the world, and got nine replies, including from five US engineers.[124] Generally, managers called for better food and living conditions for black mine workers, and for a proscription on alcohol, which they considered to be a serious issue under the previous government. Thomas Leggett, a Columbia-educated mining engineer from New Jersey, allowed that "kaffir beer"—likely referring to sorghum beer or *umqombothi* in Zulu—could be permitted if properly controlled. Leggett drew on what he described as his "own experience with a similar class of labour in Central and South America," which, he said, "has shown me that this can be done and that it is advantageous to do it."[125] Leggett, like most of

[122] Herbert Hoover to Theodore Hoover, 1899, Box 2, Theodore J. Hoover Manuscripts, Herbert Hoover Presidential Library.
[123] Rachel K. Bright, *Chinese Labour in South Africa, 1902–10: Race, Violence, and Global Spectacle* (Houndmills, UK: Palgrave Macmillan, 2013), 32. For more on Farrar, see Mae Ngai, *The Chinese Question: The Gold Rushes and Global Politics* (New York: W. W. Norton, 2021), 188.
[124] Hennen Jennings does not appear to have given his own report, but he did reply that he would attend the meeting at the Chamber of Mines. Hennen Jennings to Arthur Goldring, October 4, 1902, Elaine Katz Papers, A3424 D3.2, Historical Papers, University of the Witwatersrand.
[125] T. H. Leggett to Chamber of Mines, August 29, 1902, Elaine Katz Papers, A3424 D3.2, Historical Papers, University of the Witwatersrand. Umqombothi has a much lower alcohol content than the high proof spirits produced by government concessions pre-1899.

the other engineers, also called for the introduction of piece work and for longer contracts, though he cautioned that contract length should be flexible, given that "Transvaal Msutu, Zulu, or Southern Basutu" (referring to Xhosa, Zulu, and Sotho men) were only willing to "work for a few months, then return to their crops and come back again to work," whereas "East Coast Native[s]" (Tsonga men) could come for one to five years. It is not clear that Leggett, or any of the others, were aware of the intense degree of coercion Portuguese colonialism subjected Tsonga men to, but they were well aware of their apparent pliability.[126] Leggett's views appear to be more informed by the experience of the United States, when he warned that "any attempt to work the mines by white labour only is sure to be unsuccessful," given that, as he saw it, "Wherever white and black labour come into contact, the white laborer will always refuse to do certain classes of work performed by the black." Instead, Leggett's solution to the present "paralysis" on the Rand was to turn to a deeply racial script to increase the efficiency of black labor already in southern Africa.[127]

Leggett's assistant engineer, Fred Hellmann, who first arrived on the Rand from the US in 1895 and had published on Rand mine valuation,[128] allowed that it was possible to build up a large force of skilled white labour, but it would take an unreasonably long time to do so.[129] Even

[126] This was true of Hennen Jennings and it is unlikely any of the other Americans were better informed than he was. See "Notes on Mr. Hennen Jennings' Letter, Dated the 1st. September 1902, Dealing with the Labour Problem," September 1902, Archives of H. Eckstein & Co. For more on the Rand's connection to and reliance on colonial Mozambique, see Charles van Onselen, *The Night Trains: Moving Mozambican Miners to and from the Witwatersrand, 1902-1955* (Johannesburg: Jonathan Ball, 2019).
[127] "Letter from T. H. Leggett to Chamber of Mines." I borrow the concept of a "racial script" from Natalia Molina, *How Race is Made in America: Immigration, Citizenship, and the Historical Power of Racial Scripts* (Berkeley: University of California Press, 2014), 6–11.
[128] Fred Hellmann, *Determination of the Present Value of a Mine on the Rand* (London: Institution of Mining and Metallurgy, 1898).
[129] For a brief background on Hellman, see Maryna Fraser, *Johannesburg Pioneer Journals, 1888-1909* (Cape Town: Van Riebeeck Society, 1986), 163.

then, based on Hellmann's view of racial dynamics, the only way it would be possible is if black labor were "entirely eliminated from the working classes of the mines." Hellmann similarly called for longer engagements, lamenting that "the curse of the Industry lies so far in the fact that the mines are constantly breaking in new boys," a proposal consistent with other calls to build up the skill and capacity of African workers, as Hennen Jennings had made in 1897. Hellmann bombastically endorsed the abilities of Chinese workers based on his experience in California, calling them "the most efficient labourers in the world." If it proved impossible to recruit sufficient native labor, he said importing Chinese labor could work, provided that steps were taken to "safeguard the interests of the [white] community, which [Chinese laborers] would otherwise menace."[130]

While Hellman allowed that "the introduction of an alien race into any country is not a thing to be undertaken lightly," it was the Australian on the committee, George Denny, who most accurately apprehended the intensity of the white backlash that would happen if Chinese labor were introduced on the mines of the Rand.[131] For his part, Denny wrote that the "violent opposition which is aroused here by the mention of Chinese labour is due entirely in my mind to prejudice and perhaps ignorance." Worries in Australia and the United States about Chinese immigrants becoming "undesirable Colonists or citizens" were overblown in his view—Chinese should simply be denied citizenship, and compelled to return to China at the end of their contracts, just as they were in the "Dutch West Indies," where, he noted, the mining industry is

[130] Fred Hellman to Chamber of Mines, August 29, 1902, Elaine Katz Papers, A3424 D3.2, Historical Papers, University of the Witwatersrand.

[131] For more on how gold mining made the "Chinese question" a global issue, see Mae Ngai, *The Chinese Question: The Gold Rushes and Global Politics* (New York: W. W. Norton, 2021). On white racism in Australian gold mining, see David Dorward, "'Nigger Driver Brothers': Australian Colonial Racism in the Early Gold Coast Mining Industry," *Ghana Studies* 5 (2002): 197–214.

"operated entirely" by Chinese laborers. Still, Denny's prophecy proved to be remarkably accurate: he wrote that while Chinese laborers would lower working costs on the Rand, "it could not be effected without the most serious disturbances amongst the white workmen, leading to such embarrassment to the Government that the whole effort would probably prove abortive."[132] Hellmann was correct to be concerned, although as shown in chapter 5, it was another member of the committee, in fact, who played a central role in later making that a reality.

Concurrent to the private committee, the Chamber of Mines appointed Hennen Jennings chair of a committee of fifteen mining engineers to formally advise British Colonial Secretary Joseph Chamberlain on the pressing labor problem ahead of his visit to the Rand. At least nine were from the United States: Fred Hellmann, William Honnold, Harry Webb, George Webber, G. J. Hoffmann, Pope Yeatman, Frank Carpenter, and the two Jennings brothers, Hennen and Sidney. Unlike in 1897, at least one Afrikaner, the German-educated mining engineer Robert Kotze, was included on the committee.[133] The final report, presented to Chamberlain in January 1903 as "A Descriptive and Statistical Statement of the Gold Mining Industry of the Witwatersrand," read a great deal like Hennen Jennings' testimony in 1897. Despite the statement's claim as "descriptive and statistical" the statement was rooted in whiteness and racial supremacy, but functioned to draw attention away from the whiteness therein. Once again, working costs figured as "the cardinal factor for consideration," and

[132] G. A. Denny to Arthur Goldring, October 9, 1902, Elaine Katz Papers, A3424 D3.2, Historical Papers, University of the Witwatersrand.
[133] G. R. Bozzoli, *Forging Ahead: South Africa's Pioneering Engineers* (Johannesburg: Witwatersrand University Press, 1997), 75–78.

accordingly labor costs were of "dominating importance." Solving this "problem," the engineers reasoned, was "not only the main question for the mines, but also seems vital for the advancement and prosperity of the whole of South Africa." While claiming to have the imprimatur of scientific experiment, the recommendations were based entirely on the engineers' assessment of the colonial and racial situation. Noting that while they believed "the white race is the superior race mentally, and that the black should recognise it," "As a mere muscular machine," an African who had spent sufficient time at the mine to gain skills "is the equal of the white man." With what was surely the memory of emancipation and Reconstruction in the United States in mind, the engineers simultaneously held that if blacks worked alongside whites, whites "become declassed and ashamed of themselves."[134] Experiments in replacing black labor with unskilled whites were deemed unsatisfactory by the mine managers. In any event, in a likely comparison to the United States, "The native races have not, as in some countries, been swept away by contact with civilization." Instead they envisioned a future South Africa that was not wholly white, as others demanded, yet one where "the greatest good and harmony" would "prevail only if a distinct line is drawn, and it is recognised that the white is master and the black is man." The report continued, "For expansive prosperity, whether from the aspect of the shareholders in the mines, or the white employees thereof, we believe that an abundant supply of cheap labour drawn from the coloured races is of supreme importance, and without this aid there do not appear to be any great potentialities for the shareholder, the white mine employee, or the country at large." Accordingly, the

[134] For an excellent and relevant introduction, see Du Bois, "Back Toward Slavery," in *Black Reconstruction*, 670–710.

engineers had three concrete recommendations: increase measures at compulsion; expand the area of labor recruiting into more British territories in Africa; and, "as a last resource," import indentured Chinese laborers.[135] When he was interviewed thirteen years later, Jennings mused, "It is interesting, in looking over this most exhaustive report with its tabular statements, to see how closely the future has established some of the predictions made therein."[136]

Having presented the report to Chamberlain, who was staying at Hennen Jennings' pre-war home, Sunnyside, in suburban Parktown, during his visit to Johannesburg, Chamberlain took the message to the intercolonial conference in Bloemfontein held in March, where it was resolved that recruitment of laborers would expand north of the Zambezi River. While the conference absolutely rejected the "injurious" permanent settlement of "Asiatics," it did allow for some to be introduced if "industrial developments positively require" it.[137]

The Transvaal Labour Commission repeated many of the points made by the engineers to Chamberlain, although the Commission's ambit was extended beyond the mining industry to consider the needs of settler agriculturalists and other industries. Proceedings took place over thirty-two days, from July 21 to October 6, 1903. The majority report of the commission emphasized the severity of the labor shortage which, they noted, arose "in its present form" in 1835, since up to that point "slave labour was extensively employed in South Africa."[138] The postwar mining industry, however, was most severely affected by the shortage: the current number of 129,000 was already insufficient and was forecast to worsen when in five years' time

[135] *Further Correspondence Relating To The Affairs of the Transvaal and Orange River Colony, Presented to Both Houses of Parliament by Command of His Majesty* (London, 1904), 331–43.
[136] Rickard, *Interviews with Mining Engineers*, 247.
[137] London Secretary of the Chamber of Mines, *Notes on the Labour Position in the Transvaal* (London, 1904), 6–7.
[138] As in the rest of the British empire, emancipation took place in 1834. For more on this in context of the Cape colony, see Dooling, *Slavery, Emancipation and Colonial Rule in South Africa*.

the mining industry would need an additional 196,000 laborers. For these detailed figures they thanked Harry Webb, born in San Francisco and the son of a California pioneer.[139] The majority report did not mention Chinese laborers by name, but they hardly needed to. By then, Farrar had made his speech in favor, and more recently, H. Ross Skinner had already returned from his trip to China, California, and British Columbia to investigate the use of Chinese labor, announcing it to be "suitable."[140] So when the majority report expressed their final finding in blunt terms—"There is no adequate supply of labour in Central and Southern Africa"—everyone knew what they meant. Conversely, the minority report had the exact opposite finding: "there is sufficient labour in Central and Southern African for present requirements" which could be "supplemented and superseded by white labour." In closing, they took aim at Fred Hellman: the mineral wealth of the Transvaal, they believed, should be developed "in the interests of the [white] people of the Transvaal," not for capitalists in London or Paris. This belief formed the whole basis for their conclusions, which Hellman had called "a pernicious one."[141]

The discussions generally ignored the fact that Chinese people had been present in the Dutch Cape Colony since 1660 and some Chinese miners had migrated to the diamond and gold fields in the late nineteenth century. Still, the split report signaled that, on the eve of the arrival of the SS *Tweeddale*, carrying the first group of indentured Chinese laborers from Hong Kong who arrived on the Rand on June 19, 1904, white settler society on the Rand had split into two

[139] "Harry H. Webb Dies; Mining Engineer, 85; Once Was Manager of Rhodes Properties in South Africa," *New York Times*, June 4, 1939.
[140] *Further Correspondence Relating To The Affairs of the Transvaal and Orange River Colony, Presented to Both Houses of Parliament by Command of His Majesty*, Cd. 1895.
[141] *Reports of the Transvaal Labour Commission: Minutes of Proceedings and Evidence, Cd 1897* (London, 1904), 61.

camps, each of which could trace their origin to a conflict over the efficiency of white labor at the Village Main.[142] While the particular political struggles are a uniquely South African story, it is a story that cannot be understood without considering the many vectors from around the world that converged in the thin, dusty air of the Highveld at the turn of the twentieth century, one of the most cosmopolitan places on earth. Given how the split in settler society over the question of Chinese labor would come to shape twentieth century South African politics—discussed in the next chapter—long after the US mining engineers had departed to build their Washington, D.C., mansions, or extract human and mineral wealth from the next country on the list, it bears considering how the United States and the world more broadly shaped the social structure of the country which later became synonymous with racial inequality.[143]

This chapter has shown how primarily US engineers developed a method of combining engineering rationality with labor [race] management regimes that originated in California, took turns through Venezuela and Kimberley, and by the turn of the twentieth century had developed such a reputation for engineering "labor problems" that engineers like Jennings became consultants to not just corporations or investors but British imperial administrators as they planned to "reconstruct" society on top of the world's largest gold deposit.

Two years after giving the 1907 speech that this chapter opened with, on July 7, 1909, Edgar Laschinger again addressed the same group of engineers, this time in a lecture theater at

[142] On the *Tweeddale*, see Ngai, *Chinese Question*, 187–90.

[143] For more on how South African history in this period has been written in a narrowly national frame, see Jonathan Hyslop, "The British and Australian Leaders of the South African Labour Movement, 1902-1914: A Group Biography," in *Britishness Abroad: Transnational Movements and Imperial Cultures* (Melbourne: Melbourne University Press, 2007), 90–108. Hammond, Gardner Williams, and Hennen Jennings all bought mansions close to one another and others who came out on top of the second industrial revolution. "New Mecca For Rich: Mansions Are Transforming Sheridan Circle," *Washington Post*, June 23, 1907.

what is now the University of the Witwatersrand. Laschinger congratulated them for reducing "working costs considerably," thanks to "improved efficiency in mining and simplification of metallurgical treatment." Noting that the Rand's gold mines had for some time functioned as "the index of South African prosperity" at a national scale, Laschinger boasted that "Recent developments of this grand industry, conceived and carried out mainly by engineers, have shewn how the whole economic aspect of a country's resources may be changed, and its possibilities enlarged." Ever the progressive, Laschinger nevertheless believed that "the epoch-making period" had only just begun. The next chapter tells the story of how engineers managed to lower working costs by focusing on engineering labor, and carries that story beyond South Africa.[144]

[144] "President's Valedictory Address," *Proceedings of the South African Association of Engineers*, 14 (1909), 241.

Chapter 5. Title to the Universe: Race Management and its Discontents, 1903-1924

> One can see in Africa and in Southern Africa in particular the rise of a capitalist superstructure manned by individuals capable of consciously planning the exploitation of resources right into the next century, and aiming at racist domination of the black people of Africa until the end of time.
>
> —Walter Rodney, *How Europe Underdeveloped Africa*

Writing in 1940, W. E. B Du Bois lamented that he lacked "any clear conception or grasp of the meaning of that industrial imperialism which was beginning to grip the world" during the decade and a half from 1894 to 1910. At bottom, however, he argued that the dramatic global events were a direct result of empire: "the domination of white Europe over black Africa and yellow Asia, through political power built on the economic control of labor, income and ideas," all of which had its "echo" in the United States in the "expulsion of black men from American democracy" and "their subjection to caste control and wage slavery."[1] Du Bois's grasp of the transimperial globality of the period was, quite typically, decades ahead of professional historians. This chapter applies Du Bois's framing to an examination of white extractivism's entanglements with British, US, and Canadian settler empires, narrowing in on the role of mining engineers in attempting to manage and discipline habitually disruptive and disorderly mine workers.

As we will see, mining engineers were frequently deployed to extractive sites in response to workers—white and non-white—who refused to labor under whatever conditions that mine owners wanted. This chapter picks up where the previous one left off in the Transvaal in 1903, now under British control and in the wake of the disruption of the South African War

[1] W. E. B Du Bois, *Dusk of Dawn: An Essay Toward an Autobiography of a Race Concept* (Oxford: Oxford University Press, 2007 [1940]), 26, 48.

and what was in effect a massive general strike of African mineworkers. In response, British imperial officials infamously conducted an "experiment" with indentured Chinese laborers from 1904 to 1910. I show how the decision was first seriously proposed by Hennen Jennings based on his US experience with Chinese labor in the US post emancipation context. While the longer and larger nineteenth century background to the issue of Chinese labor, as others have shown, was closely connected to the US, historians have not understood how the experience in South Africa was so closely tied to the United States or guided by the theory and praxis of applied science.[2]

These twin influences were once again brought to bear in South Africa when intense pressure from white labor on the Rand and well beyond ended the importation of Chinese labor. In response, the mining industry turned to US engineering consultant Ross E. Browne to shape the contours of the mine workforce going forward. The chapter also demonstrates how the "white labourist" criticism of Chinese labor was itself significantly derived from engineering's ideas. African nationalist responses, too, were refracted through the US: John Dube considered the Chinese labor issue based on his US experience and education.[3] Arguably the most significant political cleavage in early 20th century South Africa's settler population, over white jobs in the mining industry, emerged out of the small network of mining engineers.

[2] Matthew Guterl and Christine Skwiot, "Atlantic and Pacific Crossings: Race, Empire, and 'the Labor Problem' in the Late Nineteenth Century," *Radical History Review*, no. 91 (Winter 2005): 40–61; Zach Sell, "Asian Indentured Labor in the Age of African American Emancipation," *International Labor and Working-Class History* 91 (2017): 8–27.

[3] John Dube was born in the Colony of Natal and as a African nationalist leader was the founding president of the South African Native National Congress. For more, see William Manning Marable, "African Nationalist: The Life of John Langalibalele Dube" (PhD Dissertation, University of Maryland, 1976); Heather Hughes, "Doubly Elite: Exploring the Life of John Langalibalele Dube," *Journal of Southern African Studies* 27, no. 3 (September 2001): 445–58; Heather Hughes, *First President: A Life of John Dube, Founding President of the ANC* (Auckland Park, South Africa: Jacana Media, 2011).

The white labourist outcry was led by British mining engineer F. H. P. Creswell, later South Africa's Minister of Labour from 1924 to 1933. The chapter then traces other connections to the United States in the period after 1910, including how increased violence underground was linked to a US mining engineer, Ruel C. Warriner. Finally, the section shows how US engineers were a significant element in the exportation of the South African model of gold mining to other parts of Africa, especially present-day Zimbabwe and Ghana. During the 1910s, white labourists in South Africa got their wish for a time in erecting a colour bar, protecting their place above African workers. Yet, by the Rand Revolt of 1922, the vision that Jennings powerfully articulated at the 1897 Industrial Commission—of a primarily African and very low paid mine workforce—eventually came to pass, although other jobs were reserved for whites. This structure of race and class—racial capitalism at its height—later came to be known as apartheid.

The second half of the chapter changes geographic focus, moving from the Rand to northeastern Ontario, Canada, the site of the next gold mining bonanza. The section first shows how closely connected gold mining on the Rand and in Ontario were, and how both were modeled on the US. Industry promoters were keen to boast that Ontario's gold output would soon surpass that of the legendary Witwatersrand. In northeastern Ontario, too, mining engineers with experience both in the US and South Africa were brought into manage a multi-ethnic mine workforce that obstinately refused to comply with capital. Though both sites were situated in settler colonies and with close ties to the British empire, in many ways the two were quite different, demographically, politically, and otherwise. Nevertheless, Ontario's gold mines

allow a consideration of how white extractivism was both materially and conceptually portable, capable of adapting to different contexts.

Even as Ontario, South Africa, and the western United States were *comparatively* different, they were each entangled in reticular webs of empire, whiteness, and technological and managerial knowledge.[4] A central aim of this chapter has been to specify where, how, and when that was manifest. While the transformations were not as immediately transformative or apparent as on the Rand, the second key intervention this chapter makes is to consider how this mobile cohort of engineers and the knowledge they carried with them and circulated through print media, spilled over in the longer run. Apprehending these larger yet slower moving changes requires us to zoom out to include northeastern Ontario and Toronto in one frame to see the site of mineral extraction alongside the equally important site of mining finance and expertise, which in the case of South Africa was far more concentrated in Johannesburg, which from the perspective of mining capital, only lacked a local labor force. Such a view, when simultaneously attentive to global and transimperial connections, makes clear that gold and silver mining restructured not just northeastern Ontario but also cemented Toronto as a site for mining finance and expertise that functioned as metropole for an empire of mining capital that by the late twentieth-century truly spread around the globe.

[4] South Africa was arguably unique even in a global context, as Jürgen Osterhammel has argued. Osterhammel, *The Transformation of the World: A Global History of the Nineteenth Century*, trans. Patrick Camiller (Princeton, NJ: Princeton University Press, 2014), 774.

The Rand and Chinese Labor, 1903-1907

The previous chapter discussed how it was chiefly the US experience of engineers that led to the decision to turn to Chinese labor for the mines of the Witwatersrand. The United States was hardly the only place on earth that mine owners and imperialists were looking, of course.[5] The British colonial office looked far and wide. Having been refused permission to recruit in West Africa, one official wrote to Barbados to ask for laborers they could contribute, only to be told that as much as colonial authorities would like to be rid of surplus population, they doubted that the wages would be sufficient to attract Barbadians.[6] The Chamber of Mines had made significant headway in their quest to lower wages in 1897 by leaning on the colonial subjugation of Mozambicans, subsidizing the Portuguese for sending black workers to the Rand. Nevertheless, as Lionel Phillips wrote, mining capitalists wished to be "independent of Portuguese goodwill."[7] The Secretary of Mines for the Transvaal in this period and later South Africa, was a British mining engineer who had just returned from working in Siam, Herbert Warington Smyth.

Scottish mining engineer Ross Skinner's tour of California, British Columbia, the Malay states, and China beginning in early 1903 was a significant factor in the decision to import Chinese workers.[8] Skinner had considerable experience at Kimberley's diamond fields as well as

[5] For an excellent overview of southern Africa's global entanglements in this period, see Jonathan Hyslop, "The World Voyage of James Keir Hardie: Indian Nationalism, Zulu Insurgency and the British Labour Diaspora 1907–1908," *Journal of Global History* 1, no. 03 (November 2006): 343–62.
[6] "Recruiting of Barbadian Labour for Transvaal Mines in South Africa," CO 28/262/9, The National Archives, Kew, January 15, 1904.
[7] On the 1897 reduction, see Patrick Harries, *Work, Culture, and Identity: Migrant Laborers in Mozambique and South Africa, c. 1860-1910* (Portsmouth, NH: Heinemann, 1994), 129–37. Lionel Phillips, *Transvaal Problems: Some Notes on Current Politics* (London: John Murray, 1905), 107.
[8] Melanie Yap and Dianne Leong Man, *Colour, Confusion and Concessions: The History of the Chinese in South Africa* (Hong Kong: Hong Kong University Press, 1996), 104–5; Matthew Guterl and Christine Skwiot, "Atlantic and Pacific Crossings: Race, Empire, and 'the Labor Problem' in the Late Nineteenth Century," *Radical History Review*,

the Rand. It was from California, however, that he took one key lesson: Chinese workers must be confined to specific jobs and living quarters, or else they would soon be excluded as they were in the United States.

Although as demonstrated in chapter 4, it was Hennen Jennings who was primarily responsible for the decision to import Chinese labor to the Rand, the figure of Herbert Hoover looms large over the issue.[9] While the role of engineers is generally underappreciated, where they are considered at all by historians it is Hoover and, to a lesser extent, Honnold are the US engineers most commonly held responsible for the brutal so-called "experiment" in Chinese mine labor. Hoover had good reason to distance himself from the widespread criticism from political opponents and others during his 1920 presidential campaign. Hoover's critics and opponents of many stripes made a great deal of it, even during his presidency as the US Communist Party (CPUSA) charged him with conceiving "the idea of enslaving Chinese coolies" in the aftermath of the South African War, "and making them work for the mere pittance which the Kaffirs had refused. Whereupon a slave-trading deal was concluded, which is so monstrous as to seem incredible."[10] Naturally this was the kind of charge Hoover sought to minimize, even if CPUSA propaganda was not at the top of his mind.

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no. 91 (Winter 2005), 47; Mae Ngai, *The Chinese Question: The Gold Rushes and Global Politics* (New York: W. W. Norton, 2021), 197–98.

[9] Herbert C. Hoover, *Principles of Mining: Valuation, Organization and Administration* (New York: Hill Publishing, 1909); Jessica Karlsson, "Herbert Hoover's Apologia of His Chinese Mining Career 1899-1912: Untangling the Refutation Campaign" (MA thesis, Harvard University, 2018); Jeremy Mouat and Ian Phimister, "The Engineering of Herbert Hoover," *Pacific Historical Review* 77, no. 4 (November 2008): 553–84; Pursell, "Herbert Hoover and the Transnational Lives of Engineers," 109–20; Roediger and Esch, *Production of* Difference, 117–23.

[10] "Herbert Hoover: Slave Trader, Negro-Hater, Jim Crow Expert," 1932, Communist Party USA files, US National Archives. With thanks to Robert Zecker.

Hoover first gained a reputation for setting different racial and ethnic groups apart in Australia, where he imported Italian laborers to Western Australia.[11] In April 1898, Hoover became superintendent of the Sons of Gwalia, an Australian mine he had recommended that his employer, Bewick, Moreing, purchase. Shortly after becoming superintendent, Hoover soon hired fifteen Italian miners, and as he reported in his monthly progress report, "the rivalry between them and the other miners is no small benefit." With mining capitalists, this tactic earned him a reputation for "efficiency."[12] Among miners, it resulted in violence: as similar tactics would in South Africa in 1922, ethnic divisions that originated on the mines erupted in a race riot in 1934.[13]

Hoover's Presidential Library in West Branch, Iowa, contains few traces of his time in South Africa, which he visited between July and August 1904. In his autobiography, Hoover writes little about South Africa, allowing only that he "visited the Transvaal to examine and negotiate some matters connected with a coal company and some gold mines which we managed." Hoover distanced himself from the Chinese labor controversy which had just begun, saying that "At this time the Rand mines had begun the importation of Chinese labor. I did not believe in it and made a short statement before the Chamber of Commerce contending that cheap labor was not economical, citing our lesser costs per ton in Australia and the United

[11] Richard Hartley, "Bewick Moreing in Western Australian Gold Mining 1897-1904: Management Policies & Goldfields Responses," *Labour History*, no. 65 (November 1993): 1–18.
[12] George H. Nash, *The Life of Herbert Hoover: The Engineer, 1874-1914* (New York: W. W. Norton, 1983), 70–79.
[13] Sarah Gregson, "War, Racism and Industrial Relations in an Australian Mining Town, 1916–1935," *The Economic and Labour Relations Review* 18, no. 1 (November 2007): 79–97. However, there were also examples of solidarity across those divisions. See Gregson, "'It All Started on the Mines'? The 1934 Kalgoorlie Race Riots Revisited," *Labour History*, no. 80 (May 2001): 21–40.

States with highly paid white labor."[14] Yet, when Hoover arrived in the Transvaal, he carried a letter of introduction from none other than fellow US mining engineer Hennen Jennings. It was likely Jennings who made the introduction to Milner as well, with whom Hoover dined in Johannesburg. As David Roediger and Elizabeth Esch have shown most clearly, Hoover was an expert "race manager." But Hoover's infamy has clouded the story of what happened during the Reconstruction era.

As Roediger and Esch have shown, Hoover's statistical claims to racial efficiency were inevitably spurious. Indeed, Hoover often contradicted his own confident declarations. For instance, in 1899, before white worker protest surged after the war, Hoover wrote to his brother Theodore from China marveling about the cost efficiency of Chinese laborers, comparing them favorably to black Africans: "we will break records in costs here when we are started - for labor is only 10 cents per diem and superior men to Transvaal niggers."[15] His firm's close connections to Australia was also a likely inducement to stay on the side of white workers. His partner Moreing made a point of this in 1904, saying that theirs was "the only mining firm in London which has set its face against Chinese labour in South Africa," believing that "skilled white labour could work the mines more cheaply."[16] In his autobiography, Hoover distanced himself from "cheap labor," referring readers instead to his 1909 textbook *Principles of Mining*. But even there, Hoover contradicts himself, now referring to the positives of "cheap" labor: "A great proportion of under ground work in a mine is of a type which can be performed after a

[14] Hoover, *Years of Adventure*, 86–87. Hoover's biographer is similarly reticent, writing only that Hoover made "a voyage to the Transvaal in mid-summer" 1904. Nash, *Life of Herbert Hoover: The Engineer*, 281.
[15] Theodore Hoover, "Letters from Herbert Hoover to Theodore" (n.d.), 31-THJ-B02-F02-China, Hoover Presidential Library, West Branch, IA.
[16] Quoted in Nash, *Life of Herbert Hoover: The Engineer*, 324.

fashion by absolutely unskilled and even unintelligent men, as witness the breaking-in of savages of low average mentality, like the South African Kaffirs."[17] Chinese labor had by then become politically untenable.

The actual "experiment" with Chinese labor on the Rand is notable for its wretched, brutal nature, as well as the intensity of the backlash from organized white labor, resulting in the "triumph of Asiatic exclusion in South Africa."[18] In total, 63,695 workers came from China to the Rand. Chinese laborers were paid half of what African laborers were, and a mere tenth of unskilled white workers.[19] Corporal punishment was common, as was the incidence of injury and death from unsafe conditions underground.[20] Records of "accidents" to Chinese workers reveal that it could often be difficult for managers to determine if injuries were indeed accidental or were instead self-inflicted. One worker accused of self-mutilation in 1906 "emphatically repudiate[ed] the suggestion," saying, "I want to go home soon: what use would it be to me to mutilate myself like this: how could I possibly work with a hand like this?"[21] The Superintendent worried that a case in which a laborer was entitled to compensation of five pounds for the "amputation of two fingers of the right hand" would "induce other labourers to endeavour to secure similar advantages," since "compensation must be paid for the loss of even one finger the same as for the loss of an arm."[22] The real opposition came from not from a

[17] Herbert C. Hoover, *Principles of Mining: Valuation, Organization and Administration* (New York: Hill Publishing, 1909), 161.
[18] Ngai, *Chinese Question*, 216.
[19] Ngai, *Chinese Question*, 217.
[20] Gary Kynoch, "'Your Petitioners Are in Mortal Terror': The Violent World of Chinese Mineworkers in South Africa, 1904–1910," *Journal of Southern African Studies* 31, no. 3 (September 2005): 531–46; Thembisa Waetjen, "Poppies and Gold: Opium and Law-Making on the Witwatersrand, 1904-10," *Journal of African History* 57, no. 3 (November 2016): 391–416.
[21] Accidents to Labourers, 1905, TAB/FLD 180, 37/6, National Archives of South Africa.
[22] Accidents to Labourers, 1905, TAB/FLD 180, 37/5, National Archives of South Africa.

humanitarian concern but from the white labourist challenge to being replaced with lower-paid non-white labor—what historian Rachel Bright has described as a "global spectacle" of outrage that put an end to the "experiment" in just a few years. Of course, this is not to suggest that the migrant labor system that replaced it—which relied on migrant African workers for most of the twentieth century—was any more humane. Indeed, the toll of the lung disease silicosis alone on African miners has been described as "genocidal." Before the monumental strike of 340,000 miners in 1987, the system was described as treating mineworkers worse than the ore they extracted. It was a system that left miners both broke and broken, as Lucas Ledwaba and Leon Sadiki have shown.[23]

Given the backlash to Chinese labor, it should not be surprising that some engineers like Honnold changed their minds entirely, even complaining that Chinese labor "efficiency is distinctly disappointing."[24] More generally, mining engineers attempted to enumerate two distinct new routes to a profitable workforce. The first, as we began to discuss in chapter 4, was embodied by Creswell's calculus that concluded white labor was more profitable. The second was already underway before the last indentured Chinese were repatriated. In many ways picking up from where Jennings was headed in 1897 at the Commission, this project aimed at demonstrating that "native" labor was the best option. The Rand's largest mining concern, the Corner House group, once again turned to a US engineer, this time Ross E. Browne.

[23] Lucas Ledwaba and Leon Sadiki, *Broke & Broken: The Shameful Legacy of Gold Mining in South Africa* (Auckland Park, South Africa: BlackBird Books, 2016), 113, 154. For an overview of management's role in the strike, see T. Dunbar Moodie, "Managing the 1987 Mine Workers' Strike," *Journal of Southern African Studies* 35, no. 1 (March 2009): 45–64.
[24] Quoted in Ngai, *Chinese Question*, 232.

F. H. P. Creswell and White Labourism

While the mining capitalists had the engineer Browne in their corner, organized white labor had their own: F. H. P. Creswell, who had been critical of the indentured Chinese labor project from the beginning.[25] Frederic Creswell was a British mining engineer, born in Gibraltar, educated at the Royal School of Mines, and like many of the engineers from the United States, had also worked in Venezuela.[26] Creswell's extensive report to the private committee stands as among the earliest expressions of white labourism coming from within the Witwatersrand gold mining industry.[27] Creswell had worked alongside American engineers for years and shared many of their habits of thought and concerns, yet he came to complete opposite conclusion. Creswell, too, worried about the "demoralising" impact of "cheap" black labor on white workers, as well as the migratory nature of African workers made it difficult to cultivate much in the way of skill. Instead of tinkering with the existing setup by altering wages, Creswell proposed a radical shift involving "freeing ourselves from dependence on the native by on the one hand establishing a white working population and on the other hand by using more labour saving appliances." Creswell's defense of white immigrants from Britain and Scandinavia was that he believed them to be more intelligent than Africans, for whom, he argued, "The idea of labour is utterly alien." On the issue of Chinese labor, which the Chamber had specifically asked

[25] F. H. P. Creswell, *The Chinese Labour Question from Within* (London: P.S. King, 1905); Simone Lisa McCallum, "Radical Racism in the Transvaal: F. H. P. Creswell and the White Labour Movement, 1902-1912" (MA thesis, Queen's University, 1994).

[26] Creswell's engineering and political career is deserving of more study. Some coverage can also be found in Yudelman, *Emergence of Modern South Africa*, 64, 218–32; Ngai, *Chinese Question*, 251–52, 264–65.

[27] For more on white labourism, see Jonathan Hyslop, "The Imperial Working Class Makes Itself 'White': White Labourism in Britain, Australia, and South Africa before the First World War," *Journal of Historical Sociology* 12, no. 4 (1999): 398–421; William Kenefick, "Confronting White Labourism: Socialism, Syndicalism, and the Role of the Scottish Radical Left in South Africa before 1914," *International Review of Social History* 55, no. 01 (April 6, 2010): 29; Lucien Van der Walt, "The First Globalisation and Transnational Labour Activism in Southern Africa: White Labourism, the IWW, and the ICU, 1904–1934," *African Studies* 66, no. 2–3 (2007): 223–51.

about, Creswell allowed that they represented the "only other alternative with the Kaffir" but "under the circumstances seems hardly worth dealing with," presumably referring to white labor's opposition to them in gold mining countries around the world. Contrary to some of the US engineers, who were renowned for their opposition to organized labor, Creswell denied that a white workforce would lead to any increase in work action or strikes. In line with his training as an engineer, Creswell based his recommendations on an experiment in utilizing white labor he had been running at the Village Main Reef mine, where he was employed as general manager, and he appeared to have statistics to back up his defend his claim. Controversy over the validity of this experiment its implications would roil the community of expatriate engineers on the Rand and have lasting implications for the future direction of what became South Africa.[28] More immediately, however, the Chamber of Mines decided to ignore Creswell's evidence and defense of white labor and in its very brief report of December 2 simply "that steps be immediately taken to send a competent person to China to ascertain what number of Chinese Coolies would be available for service at the mines, the wages they would require, term of engagement and the cost of getting them here?"[29]

Behind the scenes and out of view of government officials, two months after the Chamber of Mines had written to the canvass the engineers' private views on the labor question, Hennen Jennings had already begun to worry about Creswell's experiment at the Village Main. He wrote to his employers in London that the "matter is still having my earnest

[28] "Statement on Supply of Labour," 1902, Elaine Katz Papers, A3424 D3.2, Historical Papers, University of the Witwatersrand.
[29] "Report of Committee on White and Coloured Labour," December 2, 1902, Elaine Katz Papers, A3424 D3.2, Historical Papers, University of the Witwatersrand.

consideration," and underscored the need for unity at this "crisis" that had befallen the industry. Moreover, Jennings took issue with the "Village experiment of white labour," which he deemed "unsatisfactory." He tasked his younger brother Sydney with investigating, and found that with unskilled white labor, working costs per ton amounted to 63s per ton, which yielded 43s worth of gold per ton, a loss of 15s per ton amounting to £3000 per month to continue Creswell's experiment. The elder Jennings hoped that he could prove Creswell to be in error and force him to "publicly acknowledge it, so as not to supply him with a martyr's crown. He is, however, very set and fanatic in his views."[30] Later, by January, word was spreading, and Hennen Jennings wrote to both Milner and Chamberlain to remind them he had been engineer at Village Main, followed by his brother, assuring them that Creswell's figures were wrong.[31] The imperial officials no doubt believed Jennings, given that they moved in the same circles and shared a commitment to reducing working costs and boosting dividends, not in the cause of labor, of any race. Jennings was right to be concerned about what he deemed Creswell's fanaticism, as he was soon to be given a very public platform.

Creswell's opposition was a central element of "white labourism" in a way that most historians have not apprehended.[32] First coined by Jonathan Hyslop to describe mobile imperial working class bound by an "the element of the critique of exploitation and the element of

[30] "Letter from H. Jennings to Wernher, Beit & Co.," October 27, 1902, Volume 250, File 139, Number 53, Archives of H. Eckstein & Co.
[31] H. Jennings to Joseph Chamberlain, January 21, 1903, File 139, Number 83, Archives of H. Eckstein & Co.
[32] Creswell is discussed briefly in Edward Roux, *Time Longer Than Rope: A History of the Black Man's Struggle for Freedom in South Africa* (London: Victor Gollancz, 1948), 131–32; Ngai, *Chinese Question*, 251–52, 262–65. The emergence of the colour bar in the mining industry is vast, but see Elaine N. Katz, "The Underground Route to Mining: Afrikaners and the Witwatersrand Gold Mining Industry from 1902 to the 1907 Miners' Strike," *Journal of African History* 36, no. 3 (November 1995): 467–89; Elaine N. Katz, "Revisiting the Origins of the Industrial Colour Bar in the Witwatersrand Gold Mining Industry, 1891-1899," *Journal of Southern African Studies* 25, no. 1 (March 1999): 73–97.

racism were inextricably intermingled."[33] Building on studies of whiteness in the US, Hyslop identified three "vectors" of white labourism: colonial Australia, Cornish miners, and British unions like the Amalgamated Society of Engineers (ASE). Despite the name, this latter group consisted of skilled artisans rather than professional engineers like Creswell, schooled at the Royal School of Mines.[34] British trade unionist and MP Thomas Burt was sympathetic to Creswell on his visit to Rand, describing him as "a high-souled man, of great energy and intelligence." Burt "entirely sympathised" with Creswell's belief that "free white men should be employed in preference to indentured coolies; that the importation of tens of thousands of yellow men, under the restrictions imposed by the Ordinance must degrade labour itself, and must inevitably produce other evils of the most serious character."[35] Creswell and Labour Party.[36] J.X. Merriman mentioned to Smuts that Creswell was a big help to their side and pointed out that the training of white South African men to be mining engineers meant they

[33] Jonathan Hyslop, "The Imperial Working Class Makes Itself 'White': White Labourism in Britain, Australia, and South Africa before the First World War," *Journal of Historical Sociology* 12, no. 4 (December 1999): 398–421. For a recent historiographical reappraisal, see Duncan Money and Danelle van Zyl-Hermann, "Revisiting White Labourism: New Debates on Working-Class Whiteness in Twentieth-Century Southern Africa," *International Review of Social History*, 2021, 1–23. Other examples include Elaine N. Katz, *A Trade Union Aristocracy: A History of White Workers in the Transvaal and the General Strike of 1913* (Johannesburg: African Studies Institute, University of the Witwatersrand, 1976); Jonathan Hyslop, "The World Voyage of James Keir Hardie: Indian Nationalism, Zulu Insurgency and the British Labour Diaspora 1907–1908," *Journal of Global History* 1, no. 03 (2006): 343–62; Lucien Van der Walt, "The First Globalisation and Transnational Labour Activism in Southern Africa: White Labourism, the IWW, and the ICU, 1904–1934," *African Studies* 66, no. 2–3 (December 2007): 223–51; William Kenefick, "Confronting White Labourism: Socialism, Syndicalism, and the Role of the Scottish Radical Left in South Africa before 1914," *International Review of Social History* 55, no. 01 (2010): 29–62; Jonathan Hyslop, "A British Strike in an African Port: The Mercantile Marine and Dominion Politics in Durban, 1925," *Journal of Imperial and Commonwealth History* 43, no. 5 (2015): 882–902; Duncan Money and Danelle van Zyl-Hermann, eds., *Rethinking White Societies in Southern Africa: 1930s-1990s* (Abingdon, UK: Routledge, 2020); Duncan Money, *White Mineworker's on Zambia's Copperbelt, 1926-1974: In a Class of Their Own* (Leiden: Brill, 2022).

[34] Hyslop does consider Creswell and notes his unique middle-class background in Jonathan Hyslop, "The British and Australian Leaders of the South African Labour Movement, 1902-1914: A Group Biography," in *Britishness Abroad: Transnational Movements and Imperial Cultures* (Melbourne: Melbourne University Press, 2007), 90–108.

[35] Thomas Burt, *A Visit to the Transvaal* (Newcastle-upon-Tyne, UK: Co-operative Printing Society, 1905), 38–39.

[36] Dagmar Engelken, "A White Man's Country: The Chinese Labour Controversy in the Transvaal," in *Wages of Whiteness and Racist Symbolic Capital*, ed. Wulf D. Hund, Jeremy Krikler, and David Roediger (Berlin: LIT Verlag, 2010), 161–93.

could soon be independent.[37] Notably, both sides of the white labor question attempted to marshal engineers' imprimatur to their side.

Ross E. Browne, Ruel C. Warriner, William L. Honnold and Mine Labor, 1907-1922

Ross E. Browne came from the United States to South Africa in January 1904—six months before the first Chinese workers arrived—and stayed until September of the next year.[38] Browne's trip was an extensive consulting trip on behalf of the Corner House group. Browne was held in high estimation by other mining engineers. Hammond called him "one of the best of our American mining engineers," while as we saw, Jennings got his first steps into the mining engineering profession by working as Browne's assistant at the New Almaden mercury mine in California, and it was through Hennen Jennings that Corner House hired Browne.[39] An internal letter read of Browne, "He will probably stay a month or two here with Mr. Jennings in order to go through the mass of information which is available and which will form the basis of the investigations which Mr. Browne himself will undertake on the Rand. Advice in regard to the great problems which have to be solved in the future is the main object for which we desire to have the services of this eminent engineer. Incidentally, however, his services can be made of much use during the absence of Mr. Sidney Jennings."[40] Browne's high standing and expertise did not come cheap, as he was paid "what was stated to be a colossal salary" to advise in working costs and the deep levels.[41]

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[37] J. X. Merriman to J. C. Smuts, in *Selections from the Smuts Papers*, W.K. Hancock and Jean van der Poel, eds., vol. 2 (Cambridge: Cambridge University Press, 1966), 264–68.
[38] Browne has attracted scant attention from historians. For one brief exception, see Ngai, *Chinese Question*, 250–51.
[39] Hammond, *Autobiography*, 2:511; Rickard, *Interviews with Mining Engineers*, 226.
[40] "Extract from Messrs. Wernher, Beit & Co's Letter," Volume 208, Barlow-Rand Archives, September 9, 1903.
[41] Owen Letcher, *The Gold Mines of Southern Africa: The History, Technology and Statistics of the Gold Industry* (London: Waterlow and Sons, 1936), 160.

Browne's father, Irish-born John Ross Browne, was in California during the gold rush. Browne reported on the mass murder of indigenous Yuki people at Round Valley for *Harper's* magazine and was critical of US reservation policy and the genocide of indigenous Californians.[42] J. Ross Browne also made some of the initial surveys of California's quicksilver mines, including the New Almaden, as well as a report to the US government in 1868 on mineral resources of the US West.[43] Browne evidently saw no contradiction between extractivism and a certain kind of white settler liberalism.

Like his father, Ross E. Browne believed himself an expert on minerals and workers. Browne's visit to the Rand with his longtime assistant George Hoffmann concerned working costs and lasted twenty months. After his trip, Browne wrote to his client, "I believe we are in full agreement about the desirability of educating the general public of the Rand up to an understanding and appreciation of the vital importance of a radical reduction of working costs per ton of ore."[44] Browne and Corner House agreed that the report should be discussed at the meeting of the South African Association of Engineers such that it receive wide reception and make its way to every engineer and manager on the Rand.

Browne's vision is encapsulated here, which is worth quoting at length:

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[42] Benjamin Madley, *An American Genocide: The United States and the California Indian Catastrophe, 1846-1873* (New Haven, CT: Yale University Press, 2016), 154–55, 260, 265–66.

[43] J. Ross Browne, *Adventures in the Apache Country: A Tour Through Arizona and Sonora with Notes on the Silver Regions of Nevada* (New York: Harper & Brothers, 1871); J. Ross Browne, "Down in the Cinnabar Mines: A Visit to New Almaden in 1865," *Harper's*, 1865, 545–60; J. Ross Browne, *The Indians of California* (San Francisco: Colt Press, 1944).

[44] "Ross E. Browne to Wernher, Beit," November 9, 1905, Volume 208, Barlow Rand Archives; Browne's correspondence with mine magnate Lionel Phillips is in Transvaal Chamber of Mines 19th Annual Report. Ross Egerton Browne, *Working Costs of the Mines of the Witwatersrand* (Johannesburg: Argus, 1907).

> South Africa with its preponderating numbers of blacks is not the country for cheap white labour. The black man is there to stay, and must be dealt with. He must be controlled, and efficiency of control demands utilisation of his work. The assignment of similar work to whites and blacks would result in lowering the standard for each, and breaking down the barriers which are essential to the supremacy of the white race. A distinct line of separation in the duties of skilled white and unskilled coloured labour is of paramount importance. Fortunately for the mining industry this division of labour, with efficiency on both sides of the line, will lead to the best possible results. [45]

Browne's report was extensive, running to over fifty pages of text, formulas, charts, and graphs. It arguably represented the height of engineering's application of white extractivism. The report was essentially an extended comparison of various costs and practices between two mines in California with those on the Rand. One of the most significant variables was the ethnic and racial makeup of the mine workforce. The Rand mines employed white, Chinese, and African workers, "while the labour in the California vein-mines is exclusively white." Browne was critical of the Rand workforce in general, commenting that "Most of the labour, especially underground, is unambitious. No general spirit of competition prevails. The standard measure of a day's work is low." His sharpest criticism, however, was leveled at the "merely supervisory" nature of white labour, which took up most of the time of white workers. Worse, because of high living costs, those whites were far overpaid: "Compared with the miner of California, the average white miner of the Rand is less skilful, does less effective work, and receives nearly double the pay. The wages of machine-drill men are on the Rand 25s., in California 12.5s."[46] Browne's views echoed the ones Jennings shared before the commission in 1897. African men could be useful workers, Browne maintained, if only the state would allow them to be: "Many

[45] Ross E. Browne, "Working Costs of the Mines of the Witwatersrand," *Proceedings of the South African Association of Engineers* XII (July 1906): 289–348.
[46] Browne, "Working Costs," 330.

of the coloured men are capable of undertaking work requiring a certain amount of skill and intelligence, but this is not permitted under the regulations. As it is, he is a fairly good muscular machine, and, under proper training and control, his work constitutes much cheaper labour (per unit of work) than may be had in California for vein-mining purposes."[47] Given that white labor was too costly and drove down the working cost per ton of ore, and that African workers could be employed for so little, Browne recommended maintaining "a distinct separation in the work of the white and coloured labour:" "The coloured man will do all the work requiring no special skill, and selected coloured men will under white direction do the work of actual handling and running of machine drills underground."[48] Maintaining a colour bar in this way reflected the changed political and labor climate compared to Jennings' 1897 recommendations, which saw little room for white men in South Africa's extractive industry.

Responses to Browne's Report

Initially, Browne's report was kept confidential and inside Corner House, although Lionel Phillips admitted he had not yet "managed to get through all the appendices yet."[49] Instead, Phillips wrote in June 1906, "we are pressing the working cost and efficiency question with our own managers, without inviting any public discussion upon the Ross Browne lines yet."[50] Once public, the report made for great ammunition for critics like Creswell. While there is no direct evidence giving a reason for the June 1907 discussion of the report, it must nevertheless be understood in the context of the economic recession begun in 1906, growing protests from

[47] Browne, "Working Costs," 331.
[48] Browne, "Working Costs," 341.
[49] Lionel Phillips to J. Wernher, May 20, 1906, in *All That Glittered: Selected Correspondence of Lionel Phillips, 1890-1924*, ed. Maryna Fraser and Alan Jeeves, (Cape Town: Oxford University Press, 1977), 161.
[50] Lionel Phillips to Wernher, Beit & Co., June 18, 1906, in *All That Glittered*, 164.

unemployed Afrikaners, as well as the ongoing white miners' strike that had begun in May of that year.[51] The onset of the recession also meant that South Africa was increasingly less lucrative for US mining engineers, as Honnold noted in 1906. Further, the "vital" question for mine owners and engineers was when the new deep levels would start becoming profitable.[52]

Browne's paper was discussed at the Association of Engineers, the discussant was none other than Robert N. Kotzé. A South African-born mining engineer, Kotzé had been on the Rand since the 1890s, and would soon be appointed as Government Mining Engineer of the Transvaal, a post he held from 1908-10 on the recommendation of his close friend Smuts, and of the Union of South Africa until 1926.[53] Kotzé's largely technical remarks on Browne's report sought only to refine and improve upon Browne's research rather than overturn it. Kotzé agreed that engineers "should utilize the native where the work is of a more or less mechanical nature," but white workers should be reserved for "positions where superior intelligence is the first requirement, and where capacity for muscular work is of secondary importance." Ultimately, Kotzé concluded, "If the scheme advocated be adopted for experiment and carried to a successful issue, it is to be anticipated that our native labour difficulty will be rendered much less acute."[54] The assembled corpus of engineers expressed no collective doubt that applied science could solve what was the most urgent and intractable problem facing settler society.

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[51] Key works that address this include Charles van Onselen, "The Main Reef Road into the working class," *New Babylon, New Nineveh: Everyday Life on the Witwatersrand 1886-1914* (Johannesburg: Jonathan Ball, 2001), 309–67; Elaine N. Katz, "The Underground Route to Mining: Afrikaners and the Witwatersrand Gold Mining Industry from 1902 to the 1907 Miners' Strike," *Journal of African History* 36, no. 3 (November 1995): 467–89.
[52] Honnold to Leggett, May 21, 1906, Box 78, William L. Honnold Papers, H.Mss.0381, Special Collections at the Claremont Colleges.
[53] Yudelman, *Emergence of Modern South Africa*, 142.
[54] *Proceedings of South African Association of Engineers*, 13, 11–28.

Just a few weeks after the mining engineers met to discuss Browne's report, on June 24, the Transvaal Indigency Commission met with a US-trained mine manager, Henry Hay. Born in in El Monte, California, Hay was educated at the University of California and had considerable experience in mines in the US West and Mexico. Hay had been in South Africa since at least 1903, when he was convicted in the case of a drowning death of an African worker named Siwata, an offence that cost Hay £10.[55] The indigency commissioners were keenly interested to learn from his US experience.[56] Hay represented the Mine Managers Association, which had submitted a statement allowing that the Rand mines had little need for apprentice workers, and at that, only underground. What the commissioners pressed Hay on was the possibility of training young white men to become efficient skilled miners, or as one put it, "to take charge of the machines." (Image 4) Like Browne, Hay disdained white miners on the Rand, saying that "If 50 per cent. of these men went on the Californian fields to earn their living they could not do so." Hay explained that white immigrants to California, like Cornish miners in many places, had done the drudgery and learned the necessary skills, and as such were willing to work hard. Apprenticing young Afrikaner men to become "really efficient" miners was simply impossible in South Africa as long "as we have two classes of labour here. As long as we have black labour, the white man is going to try and get the black labour to do that work." As it had been in 1897, the post-emancipation US South was a subject of interest. Hay maintained that the coal and iron mines of Alabama and Georgia, "the white men do not do the work." Asked if southern whites had attempted to "push out the negro," Hay replied that "in fact it has been the other

[55] "Rex Versus Henry Hay," MM3, National Archives of South Africa.
[56] For how the Commission was used to cement white indigency as a question, see Lis Lange, *White, Poor and Angry: White Working Class Families in Johannesburg* (Farnham, UK: Ashgate, 2003).

way; there is more of the white men's work done now by the negroes in mining than formerly," although he allowed that in the South, "whites are still a race of overseers." Ultimately, Hay disdained poor whites in both countries, calling them "a class that do not care to be industrious and they live by their wits." His testimony was of little use to the commission's aim. One commissioner expressed surprise that Hay passed up opportunities to train "white boys" by instead using African workers. Ever a loyal white extractivist, Hay contemptuously reminded the commission that "The object of the mine management is to get work done as cheaply as possible."[57]

Meanwhile, Creswell attempted to use Browne's report to further his own case for white labourism. In response, the Chamber of Mines felt compelled to publish a letter from Browne making it clear that he was not, in fact, supportive of white labourism. Writing from Oakland, California, Browne wrote that "It is already established that a more efficient use of the Kaffir labour will result in lowering the costs materially. There appears to me no other practical way of effecting an adequate reduction. The white community will get the lion's share of the product in any event, and the smaller the costs, the greater the product."[58] Phillips replied to Browne with a report from the commission, lamenting that "you will see that very little progress has yet been made in reconciling white men to unskilled work." Phillips concurred with this vision, a plan for gold to subsidize the livelihoods of white South Africans: "by far the larger proportion of the gold produced provides sustenance for the inhabitants of the country. It follows, therefore, that the gradual reduction of working costs, which must result in an

[57] *Minutes of Evidence, Transvaal Indigency Commission, 1906-8* (Pretoria: Government Printing and Stationary Office, 1908), 342–46, 403–7.
[58] Transvaal Chamber of Mines Annual Report for the Year 1908, 19 (Johannesburg, 1909), 523–25.

increased scale of operations, and in a prolonged life for the mining industry, is of great consequence, not only to the mining industry, but to South Africa."[59]

At the same time, the 1907 Mining Commission featured testimony from US engineers Fred Hellmann, Sidney Jennings, George Webber, and William L. Honnold. Creswell seized the opportunity to cross-examine them.[60] Creswell asked Webber, "If you were able to get a white man as cheaply as a native, have you any tendency to take the native?" Webber replied: "That would depend. I should say if we had a white man that would work as cheaply as a native there would be no difference in our working costs, but unless you can make a clean sweep and substitute all coloured for white, or all white for coloured, it would not be policy to mix up the different classes."[61] Setting aside the testimony of the engineers, the report surprised no one when it advocated for a greater share of mine labor to be performed by white workers.

In the context of Browne's report, Honnold read a paper at the Fortnightly Club, which was attended by the elite of white settler society, and where, the year before, the term "segregation" had first been used.[62] Comparing the US and South Africa, Honnold contended, "the two lines of inquiry are so complimentary that it is doubtful if a sound policy could be arrived at in either country without taking into account experience in the other."[63] Honnold's comments were reflective of his intimate knowledge of what was taking place within places like

[59] Transvaal Chamber of Mines Annual Report for the Year 1908, 19 (Johannesburg, 1909), 525.
[60] *Mining Industry Commission Minutes of Evidence* (Pretoria: Government Printing and Stationery Office, 1908).
[61] *Mining Industry Commission*, 202.
[62] Martin Legassick, "British Hegemony and the Origins of Segregation in South Africa, 1901-1914," in *Segregation and Apartheid in Twentieth Century South Africa*, ed. William Beinart and Saul Dubow (London: Routledge, 1995), 49–50.
[63] "The Negro in America," Paper before the Fortnightly Club, Johannesburg, South Africa, 1908 May 21," Box 3, Honnold Papers, Special Collections at the Claremont Colleges.

the Chamber of Mines, the mining houses, and indeed in the most politically connected corridors of settler society.

Inside Corner House, internal figures updated Browne's numbers in 1909, showing that working costs had indeed decreased as a result of Chinese labor.[64] Browne's report was still top of mind for Corner House in 1913. Considering what to submit to the upcoming Economic Commission, Phillips wrote to his employer, "Ross Browne's comparison, for instance, between the labour used in California and the labour employed here, is to some extent apposite and it is of course not being lost sight of; but there may be other instances in the world that will be useful."[65] Browne himself noted that year that the Rand had surpassed California in terms of output, and lamented that working costs were rising once again.[66]

Whatever the findings of the commissions, together, Hennen Jennings and Browne's suggestions, essentially, worked for the mine owners. This was a fact the President of the South African Association of Engineers, Laschinger, recognized as he congratulated the industry on its reduction of working costs. Laschinger held that all mine managers agreed the biggest success of the Chinese labor experiment was to raise the standard of competition.[67] With Union came increased state support of the mines. One mine owner in 1909 commented that "since General Botha's government came into power in this colony it has done its utmost to assist the mines in their recruitment of labor."[68] In the wake of Browne's report, elite white settlers seem to have come to an understanding that threatening the profitability of gold mining was off the table.

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[64] "Notes Re the Working of Government Claims in the Modderfontein District," 1909, 233, Barlow Rand Archives.
[65] Phillips to Eckstein, September 25, 1913, in *All That Glittered*, 270–71.
[66] "Mr. Ross E. Browne Pays a Compliment," *South African Mining Journal*, September 1912, 32.
[67] "President's Valedictory Address," *Proceedings of the South African Association of Engineers* 14 (July 1909).
[68] "Transvaal Mine Labor," *Engineering and Mining Journal* 88, no. 22 (November 27, 1909), 1068.

US Engineers in the Union of South Africa, 1910-1922

Constitutional discussions toward political union of the colonies and republics of the Cape Colony, Natal, the Transvaal, and the Orange Free State were held in 1908 and 1909 were a whites-only affair, with the intent of solidifying white male minority rule within the British empire. Africans, South Asians, and Coloureds organized to protest their exclusion and held a counter-conference, most famously as African political leaders representing various southern African colonies met in a schoolroom in Bloemfontein in March 1909. The Convention bitterly critiqued the draft South Africa Act soon to be passed in Britain for legislating "the colour line" as "unjust to the aborigines and coloured people." The South African Native Convention marked a "major step towards the formation of a permanent national organization."[69]

Just as it was formed, however, capitalism in the Union was under serious threat from another source: white worker protest.[70] Along with the South African War, this was one reason there were fewer US mining engineers in South Africa, as young white South African men were increasingly favored for junior engineering roles. Nevertheless, US influence and the presence of Americans hardly disappeared. One avenue that did feature more US involvement was in occupational health. In 1910, as rates of the lung disease silicosis worsened among miners breathing in silica dust underground, P. Snowden suggested to the engineering association that the Rand mines learn from the US construction of the Panama Canal, and their improvement on

[69] André Odendaal, *The Founders: The Origins of the ANC and the Struggle for Democracy in South Africa* (Lexington: University Press of Kentucky, 2013), 390–97.
[70] Bill Freund, "South Africa: The Union Years, 1910-1948 - Political and Economic Foundations," in *The Cambridge History of South Africa*, ed. Robert Ross, Anne Kelk Mager, and Bill Nasson, vol. 2, 1885-1994 (Cambridge: Cambridge University Press, 2011), 212.

industrial hygiene compared to the French.[71] In 1913, Major William Gorgas, famous for that accomplishment in Panama, was invited by the Chamber of Mines to help with the situation, an invitation Gorgas accepted. Rand Mines hired Alexander J. Orenstein, an American physician who had spent seven years in Panama as an assistant to Gorgas. He ultimately stayed on the Rand until 1961.[72]

Sam Evans, the chairman of Crown Mines who had invited Gorgas in 1913, also hired another US expert, Ruel C. Warriner, to manage the largest producer of gold on the Rand.[73] Born in Montrose, Pennsylvania—coal country—and an 1894 mining engineering graduate of Lehigh University, Warriner was a deputy sheriff during the 1897 Lattimer Massacre, in which 19 unarmed striking Slavic miners were murdered by the sheriff and his deputies.[74] It is not clear that Warriner was one of the deputies who fired on the strikers, but it was reported that he among the deputies who had left town.[75] Along with the sheriff, the deputies were acquitted after a five week trial. In December, Warriner applied for a passport, and by 1898 he was in Johannesburg.[76]

By the end of the South African War in 1902, Warriner held the title of assistant to the General Manager of Rand Mines—making him a protégé of George Webber—and surveyor of

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[71] P. Snowden, "An Economic Aspect of Mine Labour as Employed on the Witwatersrand Mines," *Proceedings of the South African Association of Engineers* 14 (1910): 53–58.
[72] Jock McCulloch, "Mining Evidence: South Africa's Gold Mines and the Career of A. J. Orenstein," *Social History of Medicine* 31, no. 1 (February 2018): 61–78.
[73] Randall M. Packard, *White Plague, Black Labor: Tuberculosis and the Political Economy of Health and Disease in South Africa* (Berkeley: University of California Press, 1989), 78.
[74] "R. C. Warriner Dies at Johannesburg," *New York Times*, July 3, 1934. On the Lattimer massacre, see Michael Novak, *The Guns of Lattimer* (New York: Basic Books, 1978); Ronald L. Lewis, *Welsh Americans: A History of Assimilation in the Coalfields* (Chapel Hill: University of North Carolina Press, 2008), 228–38; Paul A. Shackel, *Remembering Lattimer: Labor, Migration, and Race in Pennsylvania Anthracite Country* (Urbana: University of Illinois Press, 2018).
[75] "A Deputy's Story," *Philadelphia Inquirer*, September 13, 1897.
[76] Warriner passport application; Fraser and Jeeves, *All That Glittered*, 390.

Crown Deep.[77] Beginning in 1910, Warriner headed Crown Mines, a role which was a challenging position for Warriner. As Honnold and others recognized in 1906, the deep levels represented the future of capitalist development on the Rand, and Warriner was tasked with using the profits from shallower mines to finance the development of new, deeper mines to the south. Warriner applied two techniques to achieve profitability: race management and mine mapping. While most mining engineers gained their experience in hard rock mining and in the US West, Warriner was well placed to exploit the deeper levels of the Rand, given that Pennsylvania's anthracite country was where mine mapping and underground visualization began.[78] These engineering techniques would be essential to extracting the deeper levels of ore. Profitable coal mining was uniquely vulnerable to labor disruption, and Warriner's experience in suppressing union activity also likely served him and Crown Mines well.[79] Coal mining's white ethnic workforce, too, may have meant Warriner's appointment was politically acceptable in a climate of white labourism. Although there were many connections between the United States and South Africa in this period, one of the most visible was the through line between Pennsylvania and the Rand: violence. Warriner's contract was contingent on him turning a profit, and his clumsy attempts at implementing "scientific management" at Crown Mines, as T. Dunbar Moodie has shown, resulted in an enormous spike in underground

[77] Alpheus F. Williams, *American Engineers in South Africa* (Kimberley, 1902), 17; "Extract from Messrs. Wernher, Beit & Co's Letter," September 9, 1903, Barlow Rand Archives.
[78] Nystrom, *Seeing Underground*, 53–83.
[79] Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (London: Verso, 2011), 12–31.

violence.[80] His reputation for harsh management surely helped Warriner earn the position of President of the Rand Mine Managers Association in 1912.[81]

Another key US influence is apparent in the visit of William Gemmill of the Chamber of Mines, Warington Smyth, Secretary of Mines and Industries, and Archie Crawford, representing labor, as South Africa's representatives to the first International Labour Conference (ILC) in Washington, D.C. in 1919. As David Yudelman has noted, "Gemmill's pivotal role in the formation of the structure of South Africa's industrial relations [his role in subjugating organized labor]—for black as well as for white workers—and as the architect of the 1922 confrontation has gone virtually unnoticed."[82] Figures from the first decade of the century like Robert Kotzé were instrumental in advancing segregationism, as he did with his testimony before the Unemployment Commission in 1920. Knighted in 1918, Sir Kotzé argued that "the reason we have white unemployment is due to the fact that we have native labour. And it seems that the whole thing is bound up with this vast problem of the native question." Kotzé warned that, "In 500 years' time there will be no white race. Those remaining will be no longer white. But if we make up our mind that we wish to survive as a white race we have to change

[80] T. Dunbar Moodie, "Maximum Average Violence: Underground Assaults on the South African Gold Mines, 1913–1965," *Journal of Southern African Studies* 31, no. 3 (November 2005): 547–67; T. Dunbar Moodie, "A Comparative Account of Deep-Level Gold Mining in India and South Africa: Implications for Workers' Lives," in *Making Sense of Mining History: Themes and Agendas*, ed. Stefan Berger and Peter Alexander (Abingdon, UK: Routledge, 2019), 88–106; Keith Breckenridge, "The Allure of Violence: Men, Race and Masculinity on the South African Goldmines, 1900-1950," *Journal of Southern African Studies* 24, no. 4 (December 1998): 669–93.
[81] *South African Mining Journal*, September 1912, 18; Anthony Hocking, *A Court of Kings: The Story of South Africa's Association of Mine Managers* (Free State: Hollards Corporate, 1997).
[82] David Yudelman, *The Emergence of Modern South Africa: State, Capital, and the Incorporation of Organized Labor on the South African Gold Fields, 1902-1939* (Cape Town: David Philip, 1984), 151–56, 206. Quotation is on 156.

the policy."[83] In just two years' time, white miners on the Rand "made up their mind" on the question to tragic effect.

The conflict that erupted on the Rand in 1922—white labourism's most spectacular clash—was an armed uprising of white miners in March 1922 known as the Rand Revolt (Image 5).[84] The trouble included what Krikler has termed "racial killings" by white miners of black people who were not miners or even connected to mining.[85] The revolt's violence engulfed wide swathes of the city, killing over two 200 workers and police. In the end the strike was violently suppressed by the South African state. In the longer run, it was responses to the Rand Revolt that were the most decisive to the political economy of twentieth century South Africa. On the mines, that meant fewer white workers and increased profits for owners.[86] In political terms, the revolt led to the election of the Pact government in 1924, an alliance of the Labour Party and National Party, intent of establishing greater independence from Britain. Along with voting in the Afrikaner nationalist and Nationalist Party leader J. B. M. Hertzog as Prime Minister, the election of the Pact installed the white labourist mining engineer and Labour Party MP Creswell as Labour Minister.

Regardless, as David Yudelman has shown, while the Pact created the impression of change in the favor of white labourists, it was not merely conservative in power, but "counterrevolutionary," cementing the alliance between capital and state.[87] The only cabinet

[83] "The Unemployment Commission," *Indian Opinion*, November 5, 1920.
[84] The best history of the Rand Revolt is Jeremy Krikler, *White Rising: The 1922 Insurrection and Racial Killing in South Africa* (Manchester: Manchester University Press, 2005). Also see Roux, *Time Longer Than Rope*, 151–60; Simons and Simons, *Class and Colour in South Africa*, 271–99.
[85] Krikler, *White Rising*, 130–50.
[86] Yudelman, *Emergence of Modern South Africa*, 191–95.
[87] Yudelman, *Emergence of Modern South Africa*, 215.

member to oppose mining capital, Creswell was incapable of implementing a white labourist agenda while in power. In practice, the Pact government's so-called "Civilized Labour Policy," which helped employ white men in state industries like railways and establish a clear racial hierarchy, left the mines unaffected. On the mines, white labor's "defeat was utter," and the South African state effectively subsidized and supported the mining industry's growing dependence on African mineworkers.[88] It was also the political vehicle for Hertzog to pass a series of segregationist so-called "Native Bills" that further undermined already deeply limited African land tenure and political power.[89] By subsidizing and shoring up whiteness—a process that continued to be guided in part by US firms like Ford Motor Company—and dispossessing Africans of their land, it was a major step toward apartheid of 1948.[90] The other key feature of the economy of apartheid, as Stanley Trapido observed during the apex of its political hegemony in 1971, was the continual low cost of mining and agricultural labor—the former the very goal of the mining engineers in 1897 and 1903.[91] Indeed, many features of the horrific migrant labor system had a great deal of staying power. As anthropologist Donald Donham has shown, ethnic divisions in South Africa's mining industry continued until at least the mid

[88] Simons and Simons, *Class and Colour in South Africa*, 300–27; Krikler, *White Rising*, 291–95; Jeremy Seekings, "'Not a Single White Person Should Be Allowed to Go Under': *Swartgevaar* and the Origins of South Africa's Welfare State, 1924–1929," *Journal of African History* 48, no. 3 (November 2007): 375–94; Higginson, *Collective Violence*, 261–306.

[89] Marian Lacey, *Working for Boroko: The Origins of a Coercive Labour System in South Africa* (Johannesburg: Ravan Press, 1981), 217; Saul Dubow, *Racial Segregation and the Origins of Apartheid in South Africa, 1919–1936* (New York: Palgrave Macmillan, 1989), 131–76.

[90] On Ford's role in poor white reform in South Africa after the Rand Revolt, see Esch, *Color Line and the Assembly Line*, 149–81.

[91] Stanley Trapido, "South Africa in a Comparative Study of Industrialisation," *Journal of Development Studies* 17, no. 3 (April 1971), 310; Dan O'Meara, *Volkscapitalisme: Class, Capital and Ideology in the Development of Afrikaner Nationalism, 1934-1948* (Cambridge: Cambridge University Press, 1983), 471; Owen Crankshaw, *Race, Class & the Changing Division of Labour Under Apartheid* (London: Routledge, 1996); Danelle van Zyl-Hermann, *Privileged Precariat: White Workers and South Africa's Long Transition to Majority Rule* (Cambridge: Cambridge University Press, 2021).

1990s.[92] The contemporary effects of white extractivism in South Africa were best characterized, once again, by Du Bois. Writing in 1930 as Smuts visited the United States and Canada, Du Bois wrote that Smuts "and his party established the color caste of South Africa in its present form," making "South Africa the worst place on earth for colored folk to live."[93]

Zimbabwe and the Gold Coast

From the start, gold mining in what is now Zimbabwe was closely tied to the Rand, with South African capital and all the major Rand companies becoming involved between 1908 and 1911.[94] But it also had close ties to the United States: Maurice Heany, born in Virginia, managed the Gwanda mines of Matabeleland.[95] Lord Robins of Rhodesia, Philadelphia-born and one of the very first Rhodes scholars, was general manager of the Chartered Company.[96] Mine managers learned labor compulsion techniques not only from South Africa but the United States as well: Minister of Mines in the 1920s H. U. Moffat complained that in the early years, "no one had a chance of being a mine manager unless he had an American accent."[97]

Similar patterns held in West Africa's Gold Coast. While coal mining in British-controlled Nigeria was an exception, with far closer ties to Northumberland, there too a mining engineer

[92] Donald L. Donham, *Violence in a Time of Liberation: Murder and Ethnicity at a South African Gold Mine, 1994* (Durham, NC: Duke University Press, 2011), 45–66. On the lives of migrant mine workers in the twentieth century, see T. Dunbar Moodie and Vivienne Ndatshe, *Going for Gold: Men, Mines, and Migration* (Berkeley: University of California Press, 1994).
[93] W. E. B. Du Bois, "Patient Asses," *Crisis*, March 1930. For more on black internationalist responses to the tour, see Robert Edgar and Myra Ann Houser, "'The Most Patient of Animals, Next to the Ass:' Jan Smuts, Howard University, and African American Leadership, 1930," *Safundi* 18, no. 1 (2016): 29–51.
[94] I. R. Phimister, "The Reconstruction of the Southern Rhodesian Gold Mining Industry, 1903-10," *Journal of African History* 29, no. 3 (1976): 465–81.
[95] Maurice Heany, *Chinese Question in Rhodesia*, 1901; van Onselen, *Cowboy Capitalist*, 142–44; van Onselen, *Chibaro*, 136.
[96] "Lord Robins of Rhodesia," *African Affairs* 61, no. 245 (November 1962), 274–75.
[97] Charles van Onselen, *Chibaro: African Mine Labour in Southern Rhodesia, 1900-1933* (London: Pluto, 1976), 137.

from Britain, William J. Leck, was put in charge of the Udi mine in 1914.[98] As was so often the case, interruptions to the process of extraction sent both capital and engineers far and wide. Although Wassa in the Gold Coast Colony's Western Province was involved in the trans-Saharan gold trade since at least 1400, since the 1870s the region's minerals had been exploited by British capital. The colony's transition to wage labor in the 1870s touched off the first discussions about importing Chinese laborers,[99] as had been done elsewhere in the British empire since the 1830s.[100] The South African War coincided with a boom in Wassa between 1900 and 1905, as capital searched for new opportunities to exploit. In 1900, engineers and promoters claimed that the "reefs in Wassa showed the formation of banket just as they were known to occur on the Rand and nowhere else."[101] The presence of so many engineers from the Rand led to the "South Africanization" of the Wassa gold mines "at all but the lowest level of the mining hierarchy."[102] Central to this was British-born Percy Tarbutt, who had worked for Rhodes' Consolidated Goldfields on the Rand since 1888 and moved to the Gold Coast in 1901. Although a handful of mine workers arrived from China in 1897 as part of an experiment by

[98] Carolyn A. Brown, *"We Were All Slaves": African Miners, Culture, and Resistance at the Enugu Government Colliery* (Portsmouth, NH: Heinemann, 2003), 107.
[99] Kwabena O. Akurang-Parry, "'We Cast About For a Remedy': Chinese Labor and African Opposition in the Gold Coast, 1874-1914," *International Journal of African Historical Studies* 34, no. 2 (2001), 367. For an overview of this transition, see Trevor R. Getz, *Slavery and Reform in West Africa: Toward Emancipation in Nineteenth-Century Senegal and the Gold Coast* (Athens: Ohio University Press, 2004), 111–36. On the Gold Coast Colony, also see Carina E. Ray, *Crossing the Color Line: Race, Sex, and the Contested Politics of Colonialism in Ghana* (Athens: Ohio University Press, 2015).
[100] On emancipation in the British empire, I am especially informed by Madhavi Kale, *Fragments of Empire: Capital, Slavery, and Indian Indentured Labor Migration in the British Caribbean* (Philadelphia: University of Pennsylvania Press, 1998).
[101] Cassandra Mark-Thiesen, *Mediators, Contract Men, and Colonial Capital: Mechanized Gold Mining the Gold Coast Colony, 1879-1909* (Rochester, NY: University of Rochester Press, 2018), 34. On mining in the Gold Coast, also see Raymond E. Dumett, *El Dorado in West Africa: The Gold-Mining Frontier, African Labor, and Colonial Capitalism in the Gold Coast, 1875–1900* (Athens: Ohio University Press, 1998). David Dorward has taken issue with what he calls Dumett's "equivocation" on racism in Gold Coast mining: Dorward, "'Nigger Driver Brothers': Australian Colonial Racism in the Early Gold Coast Mining Industry," *Ghana Studies* 5 (2002): 197–214.
[102] Mark-Thiesen, *Mediators, Contract Men, and Colonial Capital*, 46.

Governor William E. Maxwell,[103] following Maxwell's death, Tarbutt became the leader in requesting British colonial assistance in securing the importation of indentured Chinese laborers. In fact, Tarbutt served as a director for the mine Creswell was employed at, and leaked Tarbutt's plan as part of his campaign in support of white labor. When that plan failed to win favor from the British Colonial Office, Tarbutt and members of the Mine Managers' Association petitioned for a Gold Coast Agency that would operate much like the Witwatersrand Native Labour Association (WNLA), but it was turned down.[104] After the boom dissipated, the Chamber of Mines—itself organized on the South African model—in 1909 turned to "the South African strategy of control"—recruitment through African recruiting agents rather than forced labor—in the populous Northern Territories to secure labor.[105] Like other attempts at labor compulsion and control that lasted to the 1930s, none could be considered a success. As elsewhere, these failed attempts only served to fuel anticolonial nationalism.

Gold in Ontario

The early twentieth century discovery of gold in northeastern Ontario—far removed geographically from South Africa—offers a chance to see how just portable the methods and men of white extractivism were. US mining engineers continued to be lionized and aggrandized in Ontario in the first two decades of the twentieth century, and new mines in Cobalt, Porcupine, and to a lesser extent, Sudbury, continued to rely on US-born-and trained engineers,

[103] Akurang-Parry, 'We Cast About For a Remedy," 368.
[104] Mark-Thiesen, *Mediators, Contract Men, and Colonial Capital*, 119–23.
[105] Jeff Crisp, *The Story of an African Working Class: Ghanaian Miners' Struggles, 1870-1980* (London: Zed Books, 1984), 37–39; Mark-Thiesen, *Mediators, Contract Men, and Colonial Capital*, 156–57.

many with South African experience, over Canadian-trained engineers. But Ontario and Canada were not the Transvaal and South Africa, where in the latter, what was essentially a mining camp sprung up and soon came to economically dominate the region, and by union in 1910, much of South Africa. The scale of capitalist and imperialist transformation was not at all equal. Crucially, from 1900 to 1906, as Martin Legassick and others have shown, the British imperial state, working in concert with British capital, had unprecedented freedom to reshape South African society in ways that made mining the low-grade ore especially in the Witwatersrand profitable. However, Canada was different in important ways. Even as Ontario was the site from which a particular locally-inflected British liberalism colonized what became western Canada in this period, as Graeme Thompson has shown, Ontario's political economy was able to absorb and contain the changes wrought by mineral extraction, which, after all, took place 500-700km away from the provincial capital, Toronto, in comparison to the intense verticality of mining capitalism on the Rand.[106] This dispersed geography is one reason that, for white settlers, at least, elements of pre-industrial political economy and government intervention in the economy persisted through the late nineteenth and early twentieth centuries.[107]

Origins of Settler Capitalism in Northeastern Ontario

The settler polity that is commonly, if arbitrarily, dated as beginning in 1867, Canada, has long been defined by extraction.[108] Nineteenth-century Nova Scotia had an important coal

[106] Graeme Thompson, "Upper Canada's Empire: Liberalism, Race, and Western Expansion in British North America, 1860s – 1914," *Journal of Imperial and Commonwealth History* 48, no. 1 (2020): 39–70.
[107] H.V. Nelles, *The Politics of Development: Forests, Mines, and Hydro-Electric Power in Ontario, 1849-1941* (Montreal: McGill-Queen's University Press, 2005 [1974]).
[108] Pierre Belanger, ed., *Extraction Empire: Undermining the Systems, States, & Scales of Canada's Global Resource Empire, 2017-1217* (Cambridge: MIT Press, 2018). For a recent attempt to synthesize labor history and settler colonialism in Canadian historiography, see Fred Burrill, "The Settler Order Framework: Rethinking Canadian Working-Class History," *Labour/Le Travail* 83, no. 1 (2019): 173–97.

mining industry, and British Columbia, only connected to the rest of Canada by rail in 1885, featured a modest amount of gold mining.[109] But in mid-nineteenth-century Ontario, extracting minerals from the Laurentian Plateau was deemed so difficult that the provincial government was inclined to incentivize miners to try their hand by repealing all duties and taxes on mining in the General Mining Act of 1869. In the 1870s, the most profitable mine in the province, Silver Islet on the north shore of Lake Superior, was worked profitably by miners from the United States, who took advantage of the favorable tax situation. In 1883, a deposit of nickel-copper was discovered near Sudbury on the Canadian Pacific Railway right-of-way, and property rights quickly secured by a group of US investors. By 1888, this prompted the government of Oliver Mowat to convene a Royal Commission of geologists as to how to proceed.[110]

Notably, the commissioners of the report looked to both Great Britain and to the United States for models, traveling to numerous mining regions in the United States but nowhere outside of Canada or the US. The report described the geology of Ontario, thankfully noting that in 1842, Sir William Logan had begun his geological survey of Canada using terms then in use in New York state, making Canada's mineral resources legible to US investors.[111] The commissioners wrote that "The evidence that Ontario possesses great mineral wealth is abundant," but despite that promise, figures revealed the mining industry was "making slow progress."[112] In 1887, the Canadian mineral industry was valued at just over $10,000,000, but in

[109] For more on Nova Scotia coal's scientific links to Britain and the United States, see Paul Lucier, *Scientists and Swindlers: Consulting on Coal and Oil in America, 1820-1890* (Baltimore: Johns Hopkins University Press, 2008), 11–40.
[110] Nelles, *Politics of Development*, 22–25.
[111] "Report of the Royal Commission on the Mineral Resources of Ontario and Measures for Their Development" (Toronto: Ontario Legislative Assembly, 1890), 4.
[112] One of the commissioners, William Merritt, had a grandson, William Merritt III, who trained at the Royal School of Mines in London and practiced as a mining engineer.

the United States, over $500,000,000, or roughly 50 *times* more valuable. The commissioners found no desire for "radical" change in permissive mining laws favorable to industry but identified a lack of expertise as the largest obstacle. The report suggested Ontario should start off on the right foot by following the British example, "with experienced management, the best working plant," and "a sufficiency of capital." Accordingly, "establishing a School of Mines" to train mining engineers and metallurgists was necessary, the commissioners urged.[113]

Some measures of the report were carried out faithfully, with the commission's secretary, Archibald Blue, heading the Ontario Bureau of Mines and issuing its first report in 1892. That same year, the University of Toronto created a new Department of Mining Engineering, and Queen's University in Kingston, Ontario, about 250km to the east of Toronto, followed the next year.[114] Nevertheless, Mowat abruptly reversed course from longstanding practice of not taxing mining. Following the example already set by the forest industry, and perhaps persuaded of nickel's strategic importance as war materiel, the province tightened control of mining and introduced a leasehold model. The government acknowledged that it was departing from the US model advocated for by the commission. Mowat, who in the 1830s had practiced law in Kingston with Prime Minister John A. Macdonald, had by this time become one of Macdonald's fiercest adversaries, bent on preserving Ontario's political independence from the federal government. This may account for the fact that by the early 1890s, the Ontario government took a very different approach to mining, and instead tightened control of the

[113] Royal Commission, xv-xxiii.
[114] Richard White, *The Skule Story: The University of Toronto Faculty of Applied Science and Engineering, 1873-2000* (Faculty of Applied Science and Engineering, University of Toronto, 2000); Charles F. A. Hews, *A History of Mining Engineering at Queen's: The First 100 Years: 1893 to 1993* (Kingston, ON: Department of Mining Engineering, Queen's University, 1993).

industry. A Sault Ste. Marie mining convention in 1891 passed a resolution condemning the "pernicious tax on labour and capital," and called for Algoma to separate from Ontario. Although Rossiter W. Raymond, head of the American Institute of Mining Engineers (AIME) would later describe it as "a very judicious attempt to continue the encouragement of exploration and mining, with the retention of sovereign control," in many ways the foundation had been set for the future finds of the early 1900s.[115]

Silver at Cobalt, 1903-1911

The first Bureau of Mines report, like the Royal Commission that birthed it, lamented the slow progress the mining industry made. The chance discovery of silver in Cobalt in 1903—in fact one of many items long involved in trade among Indigenous groups—changed all of that, and in time made good on the province's plans laid down in the 1890s.[116] The year before, the province decided to build a railroad from Sudbury to New Liskeard, passing the *Temiskaming and Northern Ontario Railway Act* to further lumber development. As with seemingly every mineral rush, lore surrounds the discovery: in one story, lumberjacks came across some silver nuggets at Cobalt Lake. As another remembered it, "legend has it that Alfred LaRose, the blacksmith of the railway construction crew pushing the Timiskaming and Northern Ontario Railway north in 1903 to link up with the transcontinental line in Cochrane, saw a silver fox, flung his hammer at it, and chipped off a hunk of native silver from a cutting."[117] However, there was no one among the railroad laborers with any mining experience; the best that was

[115] A. Margaret Evans, *Sir Oliver Mowat* (Toronto: University of Toronto Press, 1992).
[116] Kerry Abel, *Changing Places: History, Community, and Identity in Northeastern Ontario* (Montreal: McGill-Queen's University Press, 2006), 105. On Cobalt, see Charlie Angus, *Cobalt: Cradle of the Demon Metals, Birth of a Mining Superpower* (Toronto: House of Anansi Press, 2022).
[117] Bert Whyte, *Champagne and Meatballs: Adventures of a Canadian Communist*, ed. Larry Hannant (Edmonton, AB: AU Press, 2011), 50.

hoped for was another nickel deposit like that in Sudbury to the south, which the year before had been bought up by US industrialists J. P. Morgan and Charles Schwab, working together as International Nickel (later Inco).[118] It took sending the material down to Toronto to be examined by Provincial Geologist Willett Miller to change that.

Miller had only just been installed as Ontario's first provincial geologist the year before, in 1902. Described by mining engineering chronicler T. A. Rickard as "a stalwart Anglo-Celt, a big man physically and in character [and] a scion of the Viking breed" Miller had graduated from the University of Toronto in 1890, studying for three more years as a fellow in "mineralogy and geology," and as a faculty at Queen's University's new mining engineering school, did short stints of postgraduate work at the University of Chicago, Harvard University, and Heidelberg University. Though initially reluctant to work for the province, preferring to work in industry, Miller's training and connections to wider networks of engineering proved crucial to spreading knowledge of the new find.[119]

Miller was able to determine that the find was, in fact, silver, and proceeded to bring attention.[120] Locally, however, interest in mineral extraction was at a wane, as the news came on the heels of a periodic bust. Miller lamented that although he put on a "good exhibit of these cobalt-silver ores" at the March 1904 meeting of the Canadian Mining Institute held at Toronto's unofficial mining headquarters, the King Edward Hotel, "nobody took much interest

[118] Michael Barnes, "Some Kind of Damn Metal in Cobalt," *Republic of Mining*, January 31, 2008; Rickard, *Interviews with Mining Engineers*, 358; John F. Thompson and Norman Beasley, *For the Years to Come: A Story of International Nickel of Canada* (Toronto: Longman's, 1960).
[119] Rickard, *Interviews with Mining Engineers*, 355–57, 368.
[120] For Miller's account of the events, see Willett G. Miller, "How Cobalt Was Discovered," *Globe* (Toronto), October 3, 1908.

in it."[121] Miller's report to the *Engineering and Mining Journal* in December 1903, along with his official report for the Ontario Bureau of Mines, seem to have been more instrumental in bringing attention from farther afield.[122]

Miller's report sparked one of the most colorful and dramatic mineral booms in Canadian history, but also played a role in the largest land treaty ever signed by the Canadian settler state. In 1905, Treaty No. 9 (also known as the James Bay Treaty) transferred legal title from Anishinaabe, Omushkegowuk Cree, and other indigenous communities to the Crown. The land area covers much of what settler maps depict as northern Ontario.[123] The province's representative on the Treaty Commission was a mining engineer, Daniel George MacMartin. MacMartin's diary reveals that not only was mineral extraction an important motivation for the state, but also MacMartin's discomfort with oral promises made to indigenous people that regardless of the wording of the treaty, federal commissioners assured them they would be able to continue hunting and fishing as they had.[124]

This was of little concern to the mining world, however. As it had following so many other mineral discoveries, soon the world rushed in, and "Prospectors, writers, stock brokers, and mining engineers from New York, London, Brisbane, San Francisco, and Johannesburg all journeyed to Cobalt to seek their fortune."[125] Reporting on the find in 1906, the *New York*

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[121] Rickard, *Interviews with Mining Engineers*, 359.
[122] Willett G. Miller, "Cobalt-Nickel Arsenides and Silver in Ontario," *Engineering and Mining Journal* 76 (December 10, 1903): 888–90; *Thirteenth Annual Report of the Ontario Bureau of Mines*, 1904.
[123] John S. Long, *Treaty No. 9: Making the Agreement to Share the Land in Far Northern Ontario in 1905* (Montreal: McGill-Queen's University Press, 2010).
[124] Diary – Notes, 1905, Daniel George W. MacMartin Collection, 2325.9, Queen's University Archives, Kingston, ON.
[125] Doug Baldwin, "A Study in Social Control: The Life of the Silver Miner in Northern Ontario," *Labour/Le Travailleur* 2 (1977), 80. On how mining and hydroelectrical development aided colonialism in this period, see Jean L. Manore, *Cross-Currents: Hydroelectricity and the Engineering of Northern Ontario* (Waterloo, ON: Wilfrid Laurier University Press, 1999).

Times called Cobalt a "new Eldorado."[126] In keeping with the general extractive pattern, as surface ores were quickly worked out and mining proceeded at deeper levels, mining became more industrialized and capitalized, relying primarily on skilled miners from Nova Scotia and leaving the hardest labor to Polish, Italian, Austrian, Hungarian, and Finnish immigrants.[127] As they had in South Africa, mine owners resisted purchasing pneumatic drills that would have made mining less dependent on physical hand drilling.[128] Although mine safety was abysmal, the Ontario Bureau of Mines coolly noted that one miner died for every $700,000 of ore in Cobalt, compared to every $200,000 of ore in the Transvaal.[129]

That was just one of many South African connections. It is likely that Miller's education in the United States and Germany was chiefly responsible for his credibility with the mining engineering establishment, given the longstanding preference in Canada for European, and later, US-trained mining engineers and managers. As Dianne Newell has shown, in the last decades of the nineteenth century, the vast majority of graduates of Canada's first mining engineering school, McGill University in Montreal, could not find employment in Canada, instead working in the US and in other parts of central and south America.[130] Harold Innis likewise wrote of the Kootenay region of British Columbia in the same period that "skilled managers from mines in the United States were attracted to the district."[131] The professional

[126] "New Eldorado in a Northern Ontario Wilderness: How the Mishap of a Burly Blacksmith Revealed the Wonderful Mineral Wealth of the Cobalt District," *New York Times*, May 27, 1906.
[127] Baldwin, "Study in Social Control," 82.
[128] Baldwin, "Study in Social Control," 92. For a background on mine labor in the Canadian context and more about how technological changes were decided on by capital rather than labor, see Wallace Clement, "The Subordination of Labour in Canadian Mining," *Labour/Le Travailleur* 5 (Spring 1980): 133–48.
[129] Baldwin, "Study in Social Control," 95.
[130] Dianne Newell, *Technology on the Frontier: Mining in Old Ontario* (Vancouver: University of British Columbia Press, 1986), 47.
[131] Innis, *Settlement and the Mining Frontier*, 281.

successes of US mining engineers in South Africa in the 1890s seem to have changed that, as preference shifted to engineers and managers with US training, and quite often, with experience on the Rand.

Two early engineer-managers of silver mines at Cobalt were from the United States and arrived well-versed in the practices of white extractivism: Robert Livermore of Boston had recently come from Colorado, and Percy Robbins of Chicago had spent time on the Rand. John Hays Hammond was dispatched by the Guggenheim Exploration Company to investigate a silver claim at the Nipissing mine, and his mistaken overestimation of its value represents a rare instance of Hammond or any of his US colleagues admitting a mistake.[132] Due to his southern African experience, Hammond was well placed to serve as an emissary between the United States and Canada. During the negotiations between the two countries over the reciprocity agreement of 1911 that allowed for the tariff-free flow of natural products, US President William Howard Taft asked Hammond to serve as his "unofficial messenger" to both "Premier [sic] Wilfrid Laurier and to Governor General Lord Grey, whom I had known intimately when he was an officer of the Chartered Company in the old South African days."[133] Hammond blamed the failure to reach a deal on Canadian fears of annexation.

The American Institute of Mining Engineers' 1907 meeting in Toronto functioned as the city's—and by extension, the province's—coming out party to the world of mining capital and expertise. The centerpiece of it all was a fete of John Hays Hammond at the city's unofficial mining hub, the King Edward Hotel. Hammond's reputation in Canada was significant enough

[132] Hammond, *Autobiography*, 2:515–16.
[133] Hammond, *Autobiography*, 2:575.

that in 1913, a new McGill University graduate, Guy Carleton Jones, wrote to Hammond, whom he did not know, asking about the prospects for a mining engineer in South Africa. Despite Hammond's advice that there was a better future in Canada and the United States, Carleton Jones proceeded to Johannesburg anyway, where by 1922 he managed the Sub Nigel mine.[134]

Just five years after silver had been discovered at Cobalt, a writer for the Toronto *Globe*, noting that "Ontario is now the greatest producer of minerals of all the Provinces of the Dominion," asked, "How many of its inhabitants are conscious of that fact?" The time had come, he wrote, for Ontarians to revise their "nebulous and half-baked ideas with respect to what is to become one of the great permanent industries of this Province."[135] As Miller had predicted, just the next year gold was discovered at Porcupine.

Gold at Porcupine, 1909-1927

Just as diamonds at Kimberley had laid the foundation for gold at Johannesburg, in Ontario Cobalt silver set the stage for gold at Porcupine: through capital, technology, infrastructure, and knowledge. As Harold Innis wrote, Cobalt "became the mother camp for gold mining in Porcupine and Kirkland Lake and for mining generally."[136] Less appreciated by Innis and others, though, is that as much as Cobalt served as a technical "laboratory" for Canada, Porcupine was a "school of mines" for the world.[137] Porcupine itself, the following

[134] A. P. Cartwright, *Gold Paved the Way: The Story of the Gold Fields Group of Companies* (London: Macmillan, 1967), 124–25.
[135] John A. Ewan, "Cobalt of To-Day," *Globe* (Toronto), October 3, 1908.
[136] Innis, *Settlement and the Mining Frontier*, 349.
[137] On technology, see Douglas Owen Baldwin, "Cobalt: Canada's Mining and Milling Laboratory, 1903-1918," *HSTC Bulletin: Journal of the History of Canadian Science, Technology and Medicine* 8, no. 2 (1984): 95–111; Kelsey Rolfe, "The Dome School of Mines," *CIM Magazine*, December 20, 2017.

section will demonstrate, was intentionally fostered by the Ontario government and was not simply an accident at the intersection of US and South African mining capitalisms.

Gold was discovered at Porcupine in 1909, just following the excitement of Cobalt. Peak silver production at Cobalt was reached just two years later in 1911, but Porcupine—which consists of three primary mines, Dome, McIntyre, and Hollinger—continues to be mined today.[138] Just as in Cobalt, people from the US and beyond rushed in, and it was a Californian mining engineer, William J. Loring, who was the first engineer there. Loring had worked under Hoover in Australia as part of Bewick, Moreing, and after contracting malaria on the Gold Coast of West Africa in 1908, sought a healthier climate and arrived in Porcupine in January 1910. Appalled at how "reckless" mining finance was conducted in Porcupine and Toronto, Loring later recalled how "A group of mining claims was offered to me, at my room in the King Edward hotel, Toronto, for $90,000 cash" without any report on the property, that sold two hours later for $140,000. Nevertheless confident that Porcupine would pay out, Loring decided to return to London and advise Moreing to form a company—the Northern Ontario Exploration Company—to properly finance mining.[139] When Moreing made the reverse trip a year later, following earlier disputes between Ontario's premier James Whitney and capitalists in the City of London over public ownership of hydro-electricity, Canada's high commissioner to Britain, Donald Smith (Lord Strathcona), wrote to the premier to introduce Moreing and his "staff of engineers," requesting Whitney's "advice and assistance."[140] Not far behind was W. W. Mein, son of

[138] Innis, *Settlement and the Mining Frontier*, 337.
[139] Rickard, *Interviews with Mining Engineers*, 278, 281, 284.
[140] Lord Strathcona to James Whitney, January 27, 1911, Archives of Ontario, F5 - MU 3130. For the backstory, see Andrew Dilley, *Finance, Politics, and Imperialism: Australia, Canada and the City of London, c.1896-1914* (Basingstoke, UK: Palgrave Macmillan, 2012), 73–74

Captain Thomas Mein, veteran of the El Callao in Venezuela and the Jameson Raid, son-in-law of Gardner Williams, the longtime De Beers manager, and had himself worked in South Africa since the age of 18.[141] Porcupine, without a doubt, was transimperial from the start, drawing together British and Australian capital with US engineers with South African engineering experience.

One indication of how many from the United States were in Porcupine was that in 1912, Independence Day celebrations were already taking place, led by Philadelphian capitalist Colonel Stevenson of the Pearl Lake Mine, much as they had in Johannesburg in the 1890s.[142] Even the presence of so many compatriots was not enough to stop W. W. Mein from missing South Africa, which "is always close to my heart, and particularly the mines," he wrote to the *South African Mining Journal* in 1912. Though it had only been about eight months since a devastating fire, Mein wrote that he was "trying to get this mine in good going order, and I feel I have succeeded. Everything indicates low cost of production compatible with maximum profit."[143] Mein was helped by others, like Harry Hanson, a metallurgist from California.[144] A Chicagoan, Percy Robbins, moved from Cobalt to work as an engineer at McIntyre, and his US and South African expertise was marshaled in 1914 to make the claim that Porcupine's "future gives greater promise than any known gold mining region." Allowing that the Rand is "unquestionably the greatest gold field the world has ever known," the article noted that the Rand was "much further developed" compared to Porcupine, favorable geology and future

[141] William Wallace Mein, Reminiscences of William Wallace Mein: oral history, 1961, Columbia Center for Oral History.
[142] "Fourth of July at Pearl Lake," *Porcupine Advance*, July 12, 1912; "A Good Strike Made at Porcupine," *Mining Investor*, October 7, 1912, 117.
[143] "A Line from Mr. W. W. Mein," *South African Mining Journal*, September 1912.
[144] "Henry Hanson," *Engineering and Mining Journal*, January 27, 1912, 232.

engineering work would lead Porcupine to surpass the Rand.[145] At least one fictional portrayal of the Porcupine rush imagined the US connections. Phil Moore's 1924 novel, *Slag and Gold: A Tale of the Porcupine Trail*, told the story of a young orphan from Nevada who makes his way from Goldfields, Nevada, to northern Ontario.[146]

It was a Canadian manager, however, who played one of the largest roles in Porcupine as manager of the Dome mine. H. P. de Pencier was born in Montreal and was one of a small number of Canadian engineers and managers on the Rand. In 1909, on the eve of the gold discovery at Porcupine, de Pencier left his position as manager of the Princess Estate mine, which had just the year before employed indentured Chinese laborers.[147] As manager, de Pencier was a central node in a network of mining engineers and capitalists that extended to South Africa, the United States, Great Britain, and Canada.[148]

The career of another engineer and metallurgist who was not from the United States, Maurice Summerhayes—discussed in chapter two for failing to live up to the fictional characterization of mining engineers—also demonstrates the varied routes that people and knowledge took to Porcupine. Summerhayes had spent years in the US Southwest, Mexico and Brazil before coming to Porcupine, where he made significant metallurgical improvements to the aboveground process.[149] As the First World War came to an end, in 1918 another US mining engineer with experience in South Africa was hired, A. F. Brigham of New York City, who had

[145] "Hollinger Con. Will Outstrip Famed Rand," *Porcupine Advance*, 1914.
[146] Phil Moore, *Slag and Gold: A Tale of the Porcupine Trail* (Toronto: Macmillan, 1924).
[147] "Mr. Pencier," *Rand Daily Mail*, May 25, 1909; Rachel K. Bright, *Chinese Labour in South Africa, 1902–10: Race, Violence, and Global Spectacle* (Houndmills, UK: Palgrave Macmillan, 2013), 93.
[148] Dome Mines Company fonds, F1350, Box 1 and 8, Archives of Ontario.
[149] Maurice Summerhayes, "Continuous Decantation at the Porcupine Crown Mines," *Mining and Scientific Press*, July 18, 1914.

worked with Thomas Edison before becoming a mining engineer in the anthracite fields of Pennsylvania.[150] Brigham worked as a manager for De Beers from 1903 until 1918 and was later president of the Ontario Mining Association for 1926-27.[151]

The success of white extractivism was apparent enough that just six years after the 1911 fire, boosters in Toronto were already claiming that South Africa's Rand had peaked in terms of production, and that Ontario's own Porcupine was the future gold supply for the world.[152] A decade later in 1927, the popular Canadian magazine *Maclean's* boasted that the global race for gold supremacy was down to Canada and South Africa. The article described northeastern Ontario as a strictly "Canadian accomplishment," one viewed favorably by visiting "foreign mining engineers."[153] In doing so, Canadians were not reminded that Ontario's mineral extraction was structured consciously on US and South African models, by US and British capitalists and engineers, and to a lesser degree, Canadians who had worked or studied abroad. This selective memory was of a piece with Canada's desire to pursue greater autonomy in the world but helped clear space for Canada's extractive empire.

US Mining Engineers and Race and Class in Northeastern Ontario

A strike involving coal miners in Alberta in 1906, and the involvement of Deputy Minister of Labour and future Prime Minister, William Lyon Mackenzie King, provided the backdrop for the labor issues that would unfold in Cobalt, Porcupine, and Kirkland Lake.[154]

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[150] Innis, *Settlement and the Mining Frontier*, 358. Hammond was also connected with US inventor Thomas Edison's attempt to extract gold from South African ore. Hammond, *Autobiography*, 2:481.
[151] *Syracuse Post-Standard*, October 7, 1949, 7; Innis, *Settlement and the Mining Frontier*, 358.
[152] "Looking to the Porcupine For Gold Supply of Future," *Porcupine Advance*, March 26, 1917.
[153] James A. Cowan, "Burrowing for a Billion," *Maclean's*, June 15, 1927.
[154] William M. Baker, "The Miners and the Mediator: The 1906 Lethbridge Strike and Mackenzie King," *Labour/Le Travail* 11 (Spring 1983): 89–117; Paul Craven, *"An Impartial Umpire": Industrial Relations and the Canadian State 1900-1911* (Toronto: University of Toronto Press, 1980).

Partly through King's influence, Canada took on a more active role in labor negotiations than south of the border in the United States, did a role that soon became apparent in northeastern Ontario. However, King's later involvement in Colorado following the "Ludlow Massacre" of striking mineworkers in 1914 on behalf of the Rockefeller family, suggests how white extractivism transcended national borders.[155] For instance, anti-Asian racism in the white working class in Canada, as Kornel Chang has shown for the Canadian West, was "part of a global pattern" and tied up with "transnational processes of circulation and exchange."[156] Building from the US labor historiography but focused on central and western Canada, David Goutor has shown that from the 1870s to the 1930s, Canadian labor placed immigration restriction at the top of its priorities. While they were opposed to *any* immigration, Chinese labor was what they feared most, and decried the Canadian government's failure to follow the US example of passing a Chinese Exclusion Act—passed in 1882 in the United States, and not until 1923 in Canada. Canadian unionists "admired the determination of white South Africans, who were willing to take their country to 'a state of almost civil war over the advent of coolie labor.'"[157] Canada under Prime Minister Wilfred Laurier was reluctant to criticize Milner's Chinese labor scheme in South Africa, sparking protests from whites in British Columbia and Toronto.[158] As Renisa Mawani has powerfully shown for British Columbia's "contact zone,"

[155] On the Ludlow Massacre see Andrews, *Killing for Coal*.
[156] Chang, "Circulating Race and Empire," 701; Chang, *Pacific Connections*.
[157] David Goutor, *Guarding the Gates: The Canadian Labour Movement and Immigration, 1872-1934* (Vancouver: UBC Press, 2007), 67, 71. As Jeremy Martens has shown, the Natal Act of 1897 was itself based on earlier legislation in New South Wales. Jeremy Martens, "A Transnational History of Immigration Restriction: Natal and New South Wales, 1896–97," *Journal of Imperial and Commonwealth History* 34, no. 3 (2006): 323–44.
[158] Bright, *Chinese Labour in South Africa*, 59–61. Bright argues that the muted official response owed to the fact that Laurier's political base was centered in Quebec, which did not share Anglo Canada's sympathies with the British world.

Canada was deeply embedded in these imperial and global currents.[159] On the ground in northern Ontario, however, conflicts over mine labor revolved around class and ethnic difference in ways very different from those in British Columbia, and further still from South Africa seen in the foregoing.[160] Porcupine most obviously differed from BC demographically: about two thirds of its population of 5,000 in 1911 were of British, Irish, or French ancestry, and a quarter were of Russian, Italian, German, and Scandinavian descent. The census lists just 43 "Indians," 20 Chinese, and 3 black residents.[161] Foremen and managers typically viewed Indigenous men as the least valuable workers, but it was not uncommon for them to work as casual laborers in northern Ontario, where they were valued for their skill in river drives for the logging industry.[162] Nevertheless, there is no evidence that any were employed in Porcupine.[163] As David Goutor has argued about labor's opposition to Chinese immigration in Canada, such antipathy grew more directly out of imperial currents and especially the United States than on the ground competition, as it had in South Africa.[164]

Indeed, one of the first miners on Cobalt to be fired for labor organizing was a Montanan, in 1906.[165] The next year witnessed the first major strike in Cobalt, which discouraged many white Anglo Canadians from migrating there, and led some skilled Nova

[159] Renisa Mawani, *Colonial Proximities: Crossracial Encounters and Juridical Truths in British Columbia, 1871-1921* (Vancouver: UBC Press, 2009), 9.
[160] Marilyn Lake and Henry Reynolds, *Drawing the Global Colour Line: White Men's Countries and the International Challenge of Racial Equality* (Cambridge: Cambridge University Press, 2008), 178–84.
[161] Statistics Canada, 1911 census.
[162] Ian Radforth, *Bushworkers and Bosses: Logging in Northern Ontario, 1900-1980* (Toronto: University of Toronto Press, 1987), 32–34.
[163] Nancy M. Forestell, "Bachelors, Boarding-Houses, and Blind Pigs: Gender Construction in a Multi-Ethnic Mining Camp, 1909-1920," in *A Nation of Immigrants: Women, Workers, and Communities in Canadian History*, ed. Franca Iacovetta (Toronto: University of Toronto Press, 1998), 277n23.
[164] Goutor, *Guarding the Gates*, 208.
[165] Innis, *Settlement and the Mining Frontier*, 325.

Scotian laborers to return to their home province. Cobalt soon was attracting miners from the US along with Italians, Finns, and Ukrainians who had been working on nearby projects, primarily the railroad.[166] Porcupine, too, followed patterns set in the US and echoed patterns seen at places like California's New Almaden mine, the subject of chapter 4. In the first year after the 1911 fire and amid the regrowth of the mining development, following government arbitration in the summer, news that wages would be lowered came in the fall, prompted a strike from Local 145 of the Porcupine Miners Union, affiliated with the Western Federation of Miners, in 1912.[167] Miners protested the reduction first by invoking the Industrial Disputes Act, landmark piece of industrial legislation brought about largely by future Prime Minister William Lyon Mackenzie King and the same Act which had been borrowed by South Africa.[168] A union application to the Minister of Labour under the Act simply went ignored. Instead, on November 17, after striking miners were "in control of the mines," Thiel detectives (Pinkertons) were cabled for, and at one point a "riotous mob" involving three to four hundred strikers came to violence with strike breakers.[169] Thiel detectives shot into the crowd, wounding three strikers. One sympathetic journalist's description suggests that mine owners had unsuccessfully attempted to divide ethnicities in the town, writing, "The Porcupine boys, who speak in a dozen different tongues, are standing together as one man. After five weeks of strike, their ranks still

[166] Abel, *Changing Places*, 107.
[167] Charlie Angus, *Mirrors of Stone: Fragments from the Porcupine Frontier* (Toronto: Between the Lines, 2001), 17; For more on how this intersected with a split between the Industrial Workers of the World and the American Federation of Labor, see Saku Pinta, "The Wobblies of the North Woods: Finnish Labor Radicalism and the IWW in Northern Ontario," in *The Wobblies of the World: A Global History of the IWW* ed. Peter Cole, Kenyon Zimmer, David Struthers (London: Pluto Press, 2017), 140–55.
[168] For more on the legal context, see Judy Fudge and Eric Tucker, *Labour Before the Law: The Regulation of Workers' Collective Action in Canada, 1900-1948* (Toronto: University of Toronto Press, 2004), 51–88.
[169] "Only Protected Their Precious Lives," *Porcupine Advance*, December 13, 1912.

remain unbroken." Scab labor seems to have hard to come by, perhaps as word spread: mine owners "scoured all over eastern Canada and the adjoining states but have been unable to get competent men to fill the places of the strikers."[170] Memories of the 1907 strike at Cobalt likely played a role as well.

Class conflict intersected with racial and ethnic segmentation, increasingly after the 1911 fire and the importation of more US mining engineers. The career of an engineer like Robert Livermore, of Boston, illustrates this and some of the differences with the United States. Livermore was, in the estimation of mining engineer historian Clarke Spence, merely an "'average' engineer." No doubt the fact that Livermore's father was vice-president of Michigan's massive Calumet and Hecla Copper Company, along with his Harvard and MIT education, were what propelled his career forward. Like so many other engineers, Livermore was fiercely anti-union during his time in the 1903-4 labor struggles in Telluride, Colorado, literally shooting himself in the foot as part of a "Citizens' Alliance" to combat striking miners.[171]

The first world war, however, led to a labor shortage and resulting increases in labor power. What Craig Heron and Myer Siemiatyicki have described as the "worker's revolt in Canada" led in 1916 to the federal government convening a commission to "investigate unrest" in the Cobalt district.[172] Ownership and management had refused to meet with the strikers

[170] J. D. Barry, "The Porcupine Miners of Ontario," *International Socialist Review* 13, no. 8 (February 1913): 605–6.
[171] Clark C. Spence review of Eugene Gressley, *Bostonians and Bullion: The Journal of Robert Livermore*, *American Historical Review* February 1969, 74, 3, 1104–5.
[172] Craig Heron and Myer Siemiatyicki, "The Great War, the State, and Working-Class Canada," in *The Worker's Revolt in Canada, 1917-1925*, ed. Craig Heron (Toronto: University of Toronto Press, 1998), 11–42.

which they felt would "constitute a recognition of" the Western Federation of Miners.[173] It was in this context that Livermore in his role as a manager at Cobalt, became much more sympathetic to workers, ignoring orders from his employer to discharge "enemy aliens" from the mine.[174]

Ethnic hostilities during the war led many from southern and eastern Europe to leave, causing a postwar labor shortage that coincided with a labor market depression for mine labor in Cornwall.[175] By the early 1920s, de Pencier attempted to return to the old pattern of importing Cornish mine workers from Cornwall that so many of his friends and colleagues in southern Africa had done at hard rock mines in California in the 1870s, and who represented nearly a quarter of white miners on the Rand.[176] Working conditions on the mines remained miserable, evidence by the fact that US comrades in the Spanish Civil War noted how difficult life was for the Canadians who fought alongside them, especially southern and eastern European miners.[177] Similar conditions persisted at Inco's nickel mine in Sudbury for decades as well.[178]

De Pencier's attempt to recruit Cornish miners is one clue that the race management practices devised by mining engineers hardly disappeared in the 1920s. To cite one instance,

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[173] "Report of Royal Commission Appointed to Investigate Unrest in the Mining Industry in the Cobalt District," *Labour Gazette*, October 1916, 1632–38.
[174] Gene M. Gressley, ed., *Bostonians and Bullion: The Journal of Robert Livermore* (Lincoln: University of Nebraska Press, 1968), 175; Spence, *Mining Engineers and the American West*, 170.
[175] For more on ethnic segmentation and race management, see Peter Vasiliadis, "Dangerous Truth: Interethnic Competition in a Northeastern Ontario Goldmining Community" (PhD dissertation, Simon Fraser University, 1985).
[176] John Nauright, "Cornish Miners and the Witwatersrand Gold Mines in South Africa, c. 1890-1904," *Cornish History*, 2005, 1–22; Abel, *Changing* Places, 109. Also see Innis, *Settlement and the Mining Frontier*, 362, and Domes Mines Company fonds, F1350, boxes 1, 88, Archives of Ontario.
[177] Michael Petrou, *Renegades: Canadians in the Spanish Civil War* (Vancouver: UBC Press, 2008), 16–17.
[178] Wallace Clement, *Hardrock Mining: Industrial Relations and Technological Changes at INCO* (Toronto: McClelland and Stewart, 1981).

ethnic division of the workforce at Inco's nickel mine in nearby Sudbury continued until at least the Second World War.[179] What had begun in California in the 1870s had spread widely, as chapters 4 and 5 have shown. With the end of the First World War, petroleum extraction eclipsed hard rock mining in scale. While that war surely did not usher in the end of imperialism, it was also the end of at least the *age* of empire. A massive wave of anticolonial nationalism triggered in part by mining engineers themselves—as managers, they often represented the human face of both capital and empire to many colonized workers—also meant that engineers' role was increasingly closed off. The techniques of white extractivism—fostering ethnic competition, migratory labor schemes, the reduction and abstraction of people to numbers—lived on in the age of oil. Historians have recognized that oil fueled the "American century" but less apparent is how American mining engineers fueled the age of oil.[180]

This chapter can only offer some clues to the connections between ore and petroleum extraction, but it has shown that the methods of white male extractivism were portable and mobile, moving from the United States to South Africa and further into Africa into places like what was then Rhodesia and the Gold Coast Colony, and beyond into Canada.

[179] Arn Keeling and John Sandlos, *Mining Country: A History of Canada's Mines and Miners* (Toronto: Lorimer, 2021), 85–88.
[180] David S. Painter, "Oil and the American Century," *Journal of American History* 99, no. 1 (June 2012): 24–39. One notable exception is Vitalis, *America's Kingdom*.

Images

Image 4: White Supervisor and African Workers at Village Deep

J. Wilbur Read, *Charging up Hammer Holes. Village Deep (---Illeg.) (Recto); Cutting a Timber, Village Deep. (Verso), about 1910, Gelatin Silver Print*, about 1910, about 1910, J. Paul Getty Museum, https://www.getty.edu/art/collection/objects/92383/j-wilbur-read-charging-up-hammer-holes-village-deep-illeg-recto-cutting-a-timber-village-deep-verso-american-about-1910/.

Image 5: African Workers during the Rand Revolt

Agence Rol, *Dans Le Rand*, March 1922, Estampes et photographie, Bibliothèque nationale de France, https://images.bnf.fr/#/detail/1188761.

Conclusion: Unsettling White Extractivism

Historians have lately been finding that non-human things drive history more than they once thought. David Wood, for instance, argues that humans' "desire for control is out of control" to such an extent that the Anthropocene marks "the end of human sovereignty with respect to nature."[1] Similarly, Timothy Mitchell argues in his remarkable *Carbon Democracy* that the geology of oil and coal shapes human political forms rather than vice versa. As Sara Pritchard and Thomas Zeller have shown, the question of whether humans or non-human nature ultimately rules is somewhat beside the point. Pritchard and Zeller argue against what they see as an ahistorical understanding of industrialization as a complete rupture from the past, as resource extraction has been part of human societies since at least the Neolithic Revolution. Rather, they argue, "What is at stake is not whether humans have subdued nature, or nature still rules, either imperceptibly or overtly, but rather the scale and politics of both movements and efforts."[2]

This dissertation has hewed closer to Anna Tsing's definition of history as "the record of many trajectories of world making, human and not human."[3] It has shown that geology, along with its progeny, white extractivism, is equally shaped by human culture.[4] White extractivism was birthed in the context of the post-Civil War and post-emancipation United States, when the

[1] David Wood, *Deep Time, Dark Times: On Being Geologically Human* (New York: Fordham University Press, 2019), 29. Arun Saldanha, "A Date with Destiny: Racial Capitalism and the Beginnings of the Anthropocene," *Society and Space* 38, no. 1 (2020): 12–34.
[2] Pritchard and Zeller, "Nature of Industrialization," 69–100.
[3] Tsing, *Mushroom*, 168.
[4] For an excellent demonstration of this that looks at gold mining in Nome, Alaska, see Bathsheba Demuth, "Grounding Capitalism: Geology, Labor, and the Nome Gold Rush," in Mountford and Tuffnell, eds, *A Global History of Gold Rushes* (Oakland: University of California Press, 2018), 252–72. The story of gold in Nome is repeated with a different emphasis in Demuth's magnificent environmental history of Beringia, *Floating Coast*, 199–227. My approach to culture is especially informed by Judith Butler, "Merely Cultural," *New Left Review*, no. 226 (February 1998): 33–44.

attempt at multiracial democracy (for men, at least) known as Reconstruction was subordinated to the needs of capital and to white racism in the late 1870s. The men and practices that characterized it came about from industry's need for applied (rather than natural) science, as we saw with the failure of applied geology at Harvard and the training of men like Jennings. The cultural prerogatives of extraction in California (and to a lesser degree, Nevada) powerfully shaped the ecological, racial, and gendered norms and values embedded in white extractivism, even as it moved, metamorphosed, and mobilized in places far and wide, including Venezuela, South Africa, Rhodesia, the Gold Coast Colony, Australia, and Canada. In each place, mining engineers embodied white extractivism, and tied North America and southern Africa together in a single settler colonial project. Clearly there was nothing natural or settled about this outcome.

Here, in the third decade of the twenty-first century, the technocratic, calculating optic crafted by mining engineers is becoming ever more relevant. With the end of the First World War, metal mining began to be overshadowed by oil as a focus of geopolitical strategy, culture, and economics. The practices of white extractivism did not disappear, however, but carried on in the age of oil. Today, as part of an effort to mitigate climate change, in the midst of a very much incomplete shift from carbon combustion to battery-dependent electric power, white extractivism is entering new geographies. The vast quantity of rare earth metals required to make that transition happen mean that metal mining has taken on an even greater scale than during the age of empire, when imperial regimes went to war to fill their vaults of gold. Now, among others, the United States and China vie to secure the leading role in the extraction of the rare earth metals necessary for electrification. Elsewhere, much the same hubris that

allowed for mining engineers to produce mountains of deadly mining waste visible from space is visible in another avenue of climate change mitigation. Technoscientific fixes of altering the planet's atmosphere—geoengineering—are widely more appealing than dealing with problem head.[5] The search for valuable metals continues to widen in size, as plans are floated to mine the ocean floor and even near-Earth asteroids.[6] On April 6, 2020, the United States issued an Executive Order on "Space Resources," effectively warning the rest of the world that US extractivists would not be barred from claiming space resources for themselves. The Order claimed that "Americans should have the right to engage in commercial exploration, recovery, and use of resources in outer space." Moreover, the Order held that extraterrestrial extraction would be organized on a capitalist basis from the start: "Outer space is a legally and physically unique domain of human activity, and the United States does not view it as a global commons."[7]

Back here on Earth, as in space, the coloniality of extraction continues to be an ongoing process. A consideration of the two centers of white extractivism, Johannesburg and Toronto, look much like palimpsests. While the two cities have many differences, the two mining metropolises that grew as an outcome of white extractivism, Toronto and Johannesburg, are two world leaders in mining finance and expertise.[8] Where many mining towns and cities have

[5] Clive Hamilton, *Earthmasters: The Dawn of the Age of Climate Engineering* (New Haven, CT: Yale University Press, 2013; Holly Jean Buck, *After Geoengineering: Climate Tragedy, Repair, and Restoration* (London: Verso, 2019).
[6] Olive Heffernan, "Seabed mining is coming — bringing mineral riches and fears of epic extinctions," *Nature*, July 24, 2019.
[7] Julie Michelle Klinger, *Rare Earth Frontiers: From Terrestrial Subsoils to Lunar Landscapes*, (Ithaca, NY: Cornell University Press, 2017); Megan Black, "Prospecting the World: Landsat and the Search for Minerals in Space Age Globalization," *Journal of American History* 106, no. 1 (June 2019): 97–120.
[8] For an account of this in Johannesburg, see Philip Harrison and Tanya Zack, "The Power of Mining: The Fall of Gold and Rise of Johannesburg," *Journal of Contemporary African Studies* 30, no. 4 (October 2012): 551–70.

not experienced continued growth, they represent two significant exceptions to the typical boom-bust cycle of resource economies.[9] Part of that growth has derived from a search for higher rates of return on capital in ever farther distant places. In the 1930s, greater access to aircraft aided resource extraction in places north of Porcupine and Kirkland, regions where railroad development was prohibitively expensive. In the same period, Ontario mine owners began buying shares in South African mines. In 1961, Anglo-American, the South African corporation founded by Ernest Oppenheimer and US mining engineer William L. Honnold made its first acquisition outside of Africa, purchasing the Hudson Bay Mining and Smelting Company. The acquired company's activity was long centered around Flin Flon, Manitoba, and is now headquartered in Toronto. It is no historical accident, then, that two of the world's biggest mining conventions are held in Toronto and Cape Town (the Prospectors and Development Association of Canada convention, "PDAC" and the Mining Indaba, respectively.)

In Toronto on October 14, 1904, Canada's first francophone Prime Minister Wilfrid Laurier proclaimed that "the 20th century shall be the century of Canada and Canadian development." It was a claim Laurier made many times, and in retrospect was an odd one coming from someone firmly of the nineteenth century, who had bitterly opposed Confederation.[10] No historians of the twentieth-century world have found that Laurier's prediction came true, and it may be just as well, for Laurier's vision of twentieth-century Canada was profoundly imbued with anti-Blackness, and he was too slow to respond to surging

[9] On Tkaronto's (Toronto's) environmental and settler colonial aspects, see Michelle Murphy, "Some Keywords Toward Decolonial Methods: Studying Settler Colonial Histories and Environmental Violence from Tkaronto," *History and Theory* 59, no. 3 (September 2020): 376–84. For more on Toronto's mining connections, see Niko Block, "Toronto's Buried History: The Dark Story of How Mining Built a City," *The Guardian*, accessed November 13, 2020, https://www.theguardian.com/cities/2017/mar/03/toronto-hidden-history-how-city-built-mining.

[10] Robert Bothwell, *The Penguin History of Canada*, (Toronto: Penguin Canada, 2006), 246.

Indigenous activism to put land issues on the table before being voted out of office in 1911.[11] Still, if we consider the possibility that it was J. B. Tyrrell's note sent to Laurier from Dawson City on the first day of the new century, predicting that the twentieth century would be to Canada as the nineteenth was to the United States, there may yet be some truth to the observation.[12]

In Johannesburg, the site of the Chinese mine labor "experiment" at the turn of the century, the city is now once again home to migrant Chinese workers. As Mingwei Huang has shown of petty merchants at "China Malls" in Johannesburg, as these Chinese traders rely on African labor, "It is precisely the reliance on African migrant labor and its devaluation that makes Chinese capital racial capitalism as such." Huang further argues that much "like the dialectics of exhaustion and renewal along the mining belt or boom-bust cycles of capitalism, racial capitalism continually incorporates new actors and situations to reinvent itself, including Chinese petty capitalists on the edge of global China."[13] Writing from the City of Gold, Johannesburg, Achille Mbembe has argued that "the ultimate utopia involves coming back to the Earth, the last name of a *We* that would embrace human beings as well as objects, viruses, plants, animals, oceans, machines, and all the forces and energies with which we must now learn to live in *bio-symbiosis*." Further, he argues, "racism, the ultimate neurosis of separation, remains the greatest obstacle to the idea of a *We*. As a singular form of the war of species, racism is diametrically opposed to any consciousness of the *in-common*."[14]

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[11] Asaka, *Tropical Freedom*, 194.
[12] Innis, *Settlement and the Mining Frontier*, 398, n13.
[13] Mingwei Huang, "The Chinese Century and the City of Gold: Rethinking Race and Capitalism," *Public Culture* 33, no. 2 (May 2021): 193–217.
[14] Achille Mbembe, "The Earthly Community," trans. Gila Walker, *e-flux Architecture*, October 2021, https://www.e-flux.com/architecture/coloniality-infrastructure/410015/the-earthly-community/.

What makes the above trio of palimpsests—the US and outer space, Canada's global mining empire, and the changing same of racial capitalism in Johannesburg, South Africa, during "the Chinese century" (the twenty-first) legible is the circuits of mining engineers this dissertation has traced during the late nineteenth and early twentieth centuries. Overlooked but connected to what Walter Mignolo has described as the three pillars of the colonial matrix of power: race, gender, and nature.[15] This dissertation has redrawn the map of white settlerism and extractivism in the hope that such an exercise might unsettle contemporary assemblages of extraction, racial capitalism, and colonialism.[16]

[15] Walter Mignolo, "The Invention of the Human and the Three Pillars of the Colonial Matrix of Power: Racism, Sexism, and Nature," in *On Decoloniality: Concepts, Analytics, Praxis*, ed. Walter Mignolo and Catherine E. Walsh (Durham, NC: Duke University Press, 2018), 153–76.

[16] Some recent works that attempt such an analysis not heretofore mentioned include Macarena Gómez-Barris, *The Extractive Zone: Social Ecologies and Decolonial Perspectives* (Durham, NC: Duke University Press, 2017); Peter Linebaugh, *Red Round Globe Hot Burning: A Tale at the Crossroads of Commons and Closure, of Love and Terror, of Race and Class, and of Kate and Ned Despard* (Oakland: University of California Press, 2019); Sandro Mezzadra and Brett Neilson, *The Politics of Operations: Excavating Contemporary Capitalism* (Durham, NC: Duke University Press, 2019); Amitav Ghosh, *The Nutmeg's Curse: Parables for a Planet in Crisis* (Chicago: University of Chicago Press, 2021); Rafico Ruiz, *Slow Disturbance: Infrastructural Mediation on the Settler Colonial Resource Frontier* (Durham, NC: Duke University Press, 2021).

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