Darkening Light:

Copper and Modernity in the United States and Japan

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1.1 Innovation and Invention in the 19th Century

While traveling aboard the *Sully* in 1832, aspiring artist Samuel F. B. Morse spoke to physician and geologist Charles T. Jackson about electricity's seemingly instantaneous travel through a conductive metal wire. This had been an emerging notion amongst the scientific community ever since Benjamin Franklin experimented with the movement of electricity by flying a kite during a lightning storm. Though Jackson mentioned these remarks almost in passing, Morse became immediately enthralled by this prospect of instantaneous movement. He spent the rest of this sea voyage drawing notebook sketches of hypothetical contraptions to capture this speed of movement. Five years later, in 1837, Morse developed these ideas, alongside expert scientists, to send a signal through about 550 meters of copper wire using the famous Morse code alphabet.[1] From then the era of telegraphic communication began.

Four decades later, a highly-esteemed inventor, scientist, and intellectual, Thomas Edison traveled to the office of William Wallace in Ansonia, Connecticut, dubbed "the Copper City," in 1878.[2] There he observed Wallace's crude construction of an arc lamp, emitting light by flowing electricity through two carbon plates in a round glass bowl. This demonstration intrigued Edison beyond reason, and he hastily retreated to his laboratory at Menlo Park to develop electric light into a mass commercial commodity. By October 1879, he achieved this feat, and light as humans knew and interacted with it would forever change.[3]

Through the course of innovation in human history, iconic moments such as these are often the primary focus. Such occasions emerged throughout the 19th century and the Industrial

[1] Ainissa Ramirez, *The Alchemy of Us: How Humans and Matter Transformed One Another*. (Cambridge, MA: The MIT Press, 2020), 49-69.
[2] This nickname was given to the town for its long history of manufacturing, with copper and other metals, in the region.
[3] Ramirez, *The Alchemy of Us*, 122-130.

Revolution. These creations were impressive in their own right, but our current way of life that includes these innovations on a massive scale depends intimately on a naturally occurring mineral: copper.

The period of the late 19th to early 20th century was one of significant upheaval in the world. New technologies appeared to emerge and evolve at a rapid rate, significantly altering individual lives and national outlooks. Much work has been done exploring these innovations, in electrification and telecommunication, but little has engaged with these developments in connection with the copper that allowed for their transport and networking. Applying focus to copper itself illustrates and reveals these deep-seated connections between modernity and the capitalist influence upon labor relations and the environment. Modernization through copper, specifically in the United States and Japan, shows the broader movement of industrializing countries amidst increasing global competition, and the resulting global disparities that are still observable today.

1.2 Copper in Global History

Copper has a deep history through the course of human development, exhibiting ties to ancient civilization. Archeological evidence suggests the interregional exchange of copper and metalworking in Oman and around the Persian Gulf as far back as the third millennium BCE.[4] Used for its malleability and subsequent durability, copper also made up a large part of the plows that enacted the agricultural revolution.[5] It was at this point that individuals began to specialize in areas beyond agriculture, and early town centers formed, showing a link between copper and urbanization for multiple millennia. Much later, around the 1800's CE, copper became central to

[4] Nicole Boivin and Michael D. Frachetti, *Globalization in Prehistory: Contact, Exchange, and the "People Without History."* (Cambridge: Cambridge University Press, 2018).
[5] Timothy J. Lecain, *The Matter of History: How Things Create the Past*. (Cambridge, U.K: Cambridge University Press, 2017), 270.

shipbuilding hulls and joints and mercantile exploits. Industrialization in England, and Swansea specifically, in the 1830s created a global market of demand for copper and other minerals for use in machinery parts, taking in ore from Australia, Asia, Africa, the Americas, and the Caribbean. By this point, copper was used in many everyday goods, from brewing and electrical production goods, to domestic and decorative consumer goods, and also in currency.[6]

Copper in the US and Japan before the mid-to-late 19th century experienced fairly modest production levels. In the US, copper was used for ship hulls and 10% of all currency. One account of the Butte copper mine in Montana before widespread electrification in the early 1880s even considered the discovery of copper a disappointment, saying "We all thought it a calamity. It spread a gloom over the whole camp. There were no railroads here in those days, and, of course, we had no facilities for treating copper ore."[7] Mining in Japan, of gold, silver, and copper, had been practiced in the country since the 6th century CE, and by the 17th century, copper emerged as the main extractive metal, yet again for use in ship hulls, currency, and other tools.[8] As its use in human society soon evolved, so too did the meaning of copper for human networks.

The turn of the 20th century saw massive changes in society from a few groundbreaking technological innovations, including electrification in cities and on railways and telecommunication on telegraphs, telephones, and radios. While the preceding Stone, Bronze, and Iron Ages seemed more slow and gradual, society appeared to be rapidly advancing "across

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[6] Chris Evans and Olivia Saunders, "Copper Ore: An Unlikely Global Commodity." *Commodity Histories*, www.commodityhistories.org/research/copper-ore-unlikely-global-commodity.
[7] Walker, George Levi, 1867-. *The Copper Mines of Butte And the Amalgamated Copper Company: a Reproduction of a Series of Letters Written In Butte, Mont., for the Boston Financial News, Early In August, 1900, Together With Other Information for Speculators And Investors*. Boston, Mass.: Boston Financial News, 1900.
[8] Kazuo Nimura, *The Ashio Riot of 1907: A Social History of Mining in Japan*. (Durham N.C: Duke University Press, 1997), 12.

the horizon [as] flashed the Electric Age, the Gas Age, the Machine Age."[9] Copper played a central role in all of these technologies, making up between 10 and 40 percent of the utility cost of electric light, power, railway, and telephone.[10] As material historian Timothy Lecain writes in *The Matter of History*, "None of these inventions for using electric power would have been possible absent the masses of copper that generated the electricity in dynamos, transported the resulting power over a network, and powered the electric motors with copper armatures."[11] The induction of these tools thus brought significant changes to the demand for and meaning of copper as a commodity.

1.3 The Chemistry of Copper

Understanding the physical properties of copper helps explain the element's central role in this transition to modernity. Copper has one single outer electron, which can easily be stripped and turn atoms into charged ions.[12] This makes copper especially conductive and useful for transferring electrical currents. Additionally, copper is highly malleable and toughens after being bent, making it a good tool for shaping.[13] These properties made copper ideal for constructing large networks of distribution for both electric power and telegraphic pulses. This also profoundly altered the meaning of copper from a dormant material in currency and ships to a dynamic conduit of power.

2.1 Copper Demand

[9] Arthur Barrette Parsons, 1887-, and Metallurgical American Institute of Mining. *The Porphyry Coppers*. New York: [s.n.], 1933, 20.
[10] "Copper Wire Prices Past Thirty Years Average Cost Increased during That Period, Says Knight," *The Anaconda Standard* Apr. 18 (1915): 12.
[11] Timothy J. Lecain, *The Matter of History*, 279.
[12] Lecain, *The Matter of History*, 267.
[13] Parsons, *The Porphyry Coppers*.

Demand for copper between roughly 1880 and 1920 rose to unprecedented levels globally. The need for electrification in public utilities for transit and more general needs increased world copper production from 302,000 tons in 1890 to 1,579,000 tons in 1918, and 2,305,000 tons in 1940.[14] The United States, where electrification first flourished, was a major consumer of copper, using 943,000,000 pounds in 1905 alone.[15] This was a major explosion in the domestic economy, as American miners extracted more copper ore each day in the 1900's than an entire year in the 1850's.[16]

Similarly, the emergence of Japan as a modern industrial power also coincided with its increase in the demand for copper. Following the Meiji Restoration in 1868, the Japanese political economy transitioned toward a more industrial society that necessitated the influx of modern technology.[17] One article from the 1908 *Trenton Evening Times* writes "The modern development of the electrical business in Japan has resulted in such a large demand for electrical wire that the annual sale of the article amounts to about 8,000,000 yen, or 20 million US dollars today."[18] This demand continued to grow in the Japanese economy well into the 20th century, as Americans exported 87,000,000 pounds of refined copper there in 1922.[19]

This trade and exchange between Japan and the US indicates a converging movement between both of these nations in the need for copper and modern technology. Through this historical moment, the US and Japan shared many parallels as emerging industrial powers within their respective spheres of influence. This similarity was perceptible, as one American

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[14] Sabrina Joseph, *Commodity Frontiers and Global Capitalist Expansion: Social, Ecological and Political Implications from the Nineteenth Century to the Present Day*. (Springer International Publishing, 2019), 215.
[15] "Enormous Copper Consumption," *The Idaho Daily Statesmen* Mar. 25 (1906): 21.
[16] "Striking Facts of Copper and Its Use," *The Sunday News Tribune* Nov. 15 (1908): 6.
[17] Nimura, *The Ashio Riot of 1907*, 13.
[18] "Demand For Wire In Japan Imported Article Much Better Than Article Made There--Electrical Business," *Trenton Evening Times* Aug. 18 (1908): 9.
[19] "Trade with Japan is Showing Good Increase," *The Macon Daily Telegraph* Aug. 14 (1922): 5.

newspaper even dubbed the Japanese "The Yankees of the Orient."[20] As these two nations increasingly took part in global competition for resources and power, they applied increasing control on their respective natural resource endowments, particularly in copper, both domestically and in developing countries.

Speaking more to the global scope and implications of copper, consumption of its refined form was heavily restricted to a core of industrializing countries. 80% of global copper consumption in 1933 was taken in by the United States, Germany, Great Britain, and France.[21] This is an important notion to keep in mind when considering the global dispersion of raw copper, which resides in a significant amount in areas of the "Global South" such as Chile, Mexico, and the African copper belt of the Belgian Congo and Northern Rhodesia. Contrasting the location of copper ore with its placement as a finished product in electrical and telecommuting networks highlights the blatant international inequality of access that has become such a distinct feature of modern industrial capitalism. Tracing copper through these channels reveals the intricacies of colonial exploitation in these resource-rich areas.

2.2.1 Electricity

As alluded to previously, electricity was one of the biggest technological advancements of the late 19th century, and its logistical application in society depended intimately on copper. In both Japan and the US, major electrification companies such as the Tokyo Light Company and the Edison Illuminating Company became monolithic corporate powers in their state's respective political economies.[22] Regardless of what it was ultimately used for, electrical transmission required continued use of copper wire, as described in the following article from *The Idaho Daily*

[20] "Electricity in Japan. The Yankees of the Orient Are a Progressive People," *The Biloxi Herald* July 16 (1899): 10.
[21] Parsons, *The Porphyry Coppers*.
[22] Lecain, *The Matter of History*, 276.

Statesman: "First and foremost this is an electrical age and the utilization of electricity is largely dependent upon copper. Transmission of electrical energy for use in lighting streets and dwellings, operating power plants and railways, and making possible communication by telegraph and telephone, is a prime factor in twentieth-century living."[23] For modern societies to be able to enjoy the luxuries of modern electrification, nations had to mobilize large-scale labor, at an affordable cost, and extraction processes to develop the refined copper to support it.

Some even gave explicit acknowledgment to the natural sources of this electrical power, as *The Sunday News Tribune* writes "The marvelous electrical development of the last thirty years in light, power, heat, and communication would have been impossible without the Anaconda, the Calumet and Hecla, the Boston and Montana, and the Copper Queen."[24] These mineral deposits and industrial mines served as the foundation for supporting the iconic bright landscapes of 20th-century metropoles.

Japanese use of electrification evolved similarly. In 1903, the Japanese state invested 14 million dollars in support of electricity. In 1907 this annual investing commitment had grown to 68 million dollars, at which time the cities of Osaka and Tokyo each contained over 100 thousand lights.[25] By 1911, the Japanese economy possessed 879 electric works that harbored 400 thousand kilowatts of electric power.[26] By 1921, the electrical industry of Japan employed the most workers in the nation alongside shipbuilding, and electrical and mechanical engineering were the most popular degrees at the Imperial University of Tokyo and Kyoto. Saitaro Oi, leader of the Nippon Electric Company of Tokyo, claimed "Many of the Japanese homes have electric

[23] "Enormous Copper Consumption," *The Idaho Daily Statesmen* Mar. 25 (1906): 21.
[24] "Striking Facts of Copper and Its Use," *The Sunday News Tribune* Nov. 15 (1908): 6.
[25] "Electricity in Japan," *Trenton Evening Times* Nov.19 (1908): 7.
[26] "Interesting Items," *The Savannah Tribune* Aug. 12 (1911): 6.

light and telephones, for they have become everyday necessities."[27] By 1933, 90% of Japanese homes were endowed with electricity.[28] The commodification of electricity into a mass consumer good that seemed essential for survival could not have been attained without the large copper extracts to support it and in areas beyond the domestic sphere. This reliance on imports for modernity shaped Japanese open trade relations in this period.

2.2.2 Railways

One of the most important applications of electricity in this period was for electric street cars and railways. This became a pressing issue in the United States in 1920 when members at a four-day convention of the National Electric Light Association in Pasadena, California decided to unite the electric power companies of the US and electrify railroads to remove their dependence on coal for power.[29] Japan also experienced a rapid change concerning electric railways. In 1895, the country had no electric railways within or between the large cities of Tokyo, Osaka, or Kyoto.[30] By 1911, they had developed 31 such railways, comprising 507 miles of track.[31] In 1920, the Japanese state invested 200 million yen, or 24 million US dollars today, to "substitute electricity for steam on all lines within the empire."[32] These investments were intentionally made within the context of increasing global industrial competition. Modernizing industrial nations was essential for maintaining economic and political power globally.

2.3 Telecommunication

[27] "Electricity in Japan," *The Idaho Daily Statesmen* Sep. 9 (1921): 4.
[28] Lecain, *The Matter of History*, 276.
[29] "To Run Roads by Electricity. National Association Would Cut H. C. L. by Running Trains with Electricity," *The Emporia Gazette* May 18 (1920): 10.
[30] "Electricity in Japan," *Broad Axe* Aug. 15 (1895): 3.
[31] "Interesting Items," *The Savannah Tribune* Aug. 12 (1911): 6.
[32] "Japan Will Substitute Electricity for Steam," *The Bellingham Herald* Sep. 22 (1920): 1.

In a somewhat different avenue of modern development, copper also played a crucial role in emerging networks of telecommunication, including telegraphs, telephones, and radios. One such article from the New Mexico-based *Albuquerque Morning Journal* works to demystify this centrality of copper, a central good in that state, in communication systems: "Almost daily one reads of the perfection of the wireless telephone - in theory. Yet today we are as far from wireless telephony as ever. And so the telephone companies continue to invest their millions in copper wire."[33] The Bell Telephone Company spent 62.5 million dollars on copper wire in the year 1906 alone. Its international system implements 5 million miles of copper wire, which weighs a total of 320 million pounds and could stretch across the globe 360 times.[34] Similarly, telegraphs in the US helped connect urban centers. One such wire established in 1910 connected Chicago, Minneapolis, Monbridge, Butte, Seattle, and Tacoma, for conducting business in mainly railroads. This telegraph stretched over 2177 miles.[35] Once again, copper was central to these emerging systems.

Japan experienced similar progressions in telecommuting networks. In 1911, the country boasted 109,782 telephone subscribers and the *Biloxi Herald* noted the country had telegraph lines that "extend the length and breadth of the empire, connecting all the larger and most of the smaller towns."[36] Globally speaking as well, telegraphs integrated nations more intimately than ever before. The transatlantic copper cable, for example, brought constant communication between the US and Great Britain, as well as the Eastern and Western hemispheres more

[33] "Millions in Copper Wire Increase in Value Means More Taxes for Telephone Companies," *Albuquerque Morning Journal* Dec. 1 (1906): 7.
[34] "Enormous Copper Consumption," *The Idaho Daily Statesmen* Mar. 25 (1906): 21.
[35] "Wire Extends to Coast Cities Copper Circuit from Chicago to Seattle Installed by Milwaukee Road," *Aberdeen Daily News* Feb. 14 (1910): 7.
[36] "Interesting Items," *The Savannah Tribune* Aug. 12 (1911): 6.
"Electricity in Japan. The Yankees of the Orient Are a Progressive People," *The Biloxi Herald* July 16 (1899): 10.

generally.[37] This increased globalization had meaningful implications for both industrial and developing nations as their interaction became ever more interconnected.

In yet another aspect of emerging communication, copper played a central role in the development of the radio. The *Fort Wayne News Sentinel* makes note of copper's centrality to this new product

> The amateur as well as the professional finds himself working with a maze of copper wires and brass posts, plugs, and bases. The headphones for instance have concealed in their covering a mile of enameled copper wire with a diameter about the size of a human hair.[38]

Technology such as these illuminate the many ways in which copper helped conduct this transition into a modern way of living that incorporated bright lights and fast messages. Tracing the source and extraction of copper, however, reveals that this transition was not as progressive as it purports to be.

The very nature and appeal of copper in its support for modernity serves as a tool for understanding the obscurity behind electrical and natural power in the nineteenth century. Copper wire was of such utility because it connected the natural power of waterways or burnt coal to the energy of emerging modern metropoles, lighting streets and powering railways. In another respect, copper carried messages almost instantaneously across vast distances via telegraph, telephone, and radio. In these popular understandings of nineteenth-century history, copper helped facilitate increasing global and regional interconnectedness. In the same respect, copper worked to disconnect and dissociate just as much. As urbanites consumed increasing amounts of electricity through a network of seemingly imperceptible copper wires, they became

[37] "Making the Atlantic Cable: How it Grows from the First Copper Wire," *The Philadelphia Inquirer* July 1 (1894): 9.
[38] "Radio is Anything but 'Wireless;' Fans Find It Takes a Lot of Copper," *Fort Wayne News Sentinel* Aug. 13 (1922): 11.

further unaware of the toil of labor and ecology that supported such a system of wiring and power.

3.1 Copper Production

In both Japan and the US, extensive copper mines emerged and developed to help support the growing demand for modern technologies, and indirectly demand for the copper itself. The first major copper districts in America arose in Michigan, before the emergence of electrification. This area continued to extract considerable portions of copper, producing 27.8 million pounds in 1914.[39] The portion of the US that came to be the preeminent mining region was at Butte, Montana. Originally explored as a mining region for gold and silver, the Anaconda copper claim in Butte was unintentionally discovered in 1875, just before large advancements in electrification multiplied the need for copper.[40] This mining claim soon became a massive source. In 1900, miners extracted 6000 tons of ore daily, amassing 235 million pounds of copper for the year. This was 25% of the total global output, and the Anaconda claim only spanned about 400 acres of total surface area.[41] It is interesting to consider how such a small plot of land became so essential for the propagation of modernity on an international scale. For the US as a whole, copper production soared during this period, from 17% of total global output in 1880 to 56% in 1900.[42]

Japan also experienced a surge in its domestic copper production during this time. Following the Meiji Restoration, the state economy became increasingly integrated into global trade, Western technology, and mining.[43] For the first time, mine operators began implementing

[39] Baltic Mining Company, et al.. *Annual Report*. Boston, Mass.
[40] Maxwell Whiteman, *Copper for America: the Hendricks Family and a National Industry, 1755 - 1939*. New Brunswick (N.J: Rutgers University Press, 1971).
[41] Walker, *The Copper Mines of Butte And the Amalgamated Copper Company*, 1900.
[42] Joseph, *Commodity Frontiers and Global Capitalist Expansion*, 219.
[43] Nimura, *The Ashio Riot of 1907*, 13.

machinery in the extraction process. In 1870, the government contracted German geologist Baron von Richthofen to observe mines and create a mining school, while also drawing on expert advice from England, America, and France for mining industry reform.[44] The globalizing links between copper and industrialization are especially evident here.

From these efforts, the copper mining industry in Japan expanded and grew significantly. Similar to the Anaconda mine in the US, the Ashio mine in central Japan soon became the dominant source of copper in the country. By 1885, the Ashio was producing 39% of the total copper output in the nation.[45] The country's copper industry grew in general as well, with 66 total copper mines in 1913.[46] In 1908, Japan had produced 2.3 million dollars worth of copper.[47] By 1914, it was producing 2 million pounds of copper monthly.[48] This was significantly less than US production at the time, but significant comparatively to the size of the Japanese state.

4.1 Concentrating Capital

One of the most important developments from the increased demand for and production of copper was the concentration of capital, wealth, and power that resulted from this dynamic. In an important Anaconda Copper Company legal dispute, US Circuit Court Judge Marshall expressed consideration of the purported equality of individuals in American society: "Fundamental and inexorable in its equality is the law that no person can have more rights than his neighbor because fortune has so shaped conditions that the one owns more money or land or

[44] American Institute of Mining and Metallurgical Engineers. *Mining And Metallurgy.* [New York, N.Y.]: The Institute, 19201948.
[45] Nimura, *The Ashio Riot of 1907*, 19.
[46] Joseph, *Commodity Frontiers and Global Capitalist Expansion*, 220.
[47] Chishitsu Chōsajo (Japan). *Distribution of Minerals In the Japanese Empire And the Corean Peninsula*. [Tokyo, 191011.
[48] "Comes from Japan Study Mining Here. Japanese Mine Manager Who Has Visited Butte Before," *The Anaconda Standard* July 31 (1914): 8.

chattels than the other."[49] Though this remains a dominant ideology in American discourse, in practice individuals who gained control of concentrated capital in the US economy also wielded disproportionate power. At the start of mass electrification and telecommunication, those with significant claims to copper became millionaires overnight. This new class of powerful financial elites created dynamics with consumers and laborers that added new perspectives to the induction of modernity.

The electrification and telecommunication of the US increased copper demand and created new industrial barons. Marcus Daly bought a 12 to 15 thousand dollar claim in the Anaconda Mine in 1881 out of speculation, and that same property was then valued at 30 million dollars in 1898.[50] Copper made similar fortunes for mining kings George Hearst and James Haggin.[51] One of the more influential men in the copper mining industry and the 19th-century economy in general was Daniel Cowan Jackling. Jackling revolutionized the mining extraction process through a method known as "non-selective" or "open-pit" mining, which is referred to by Timothy Lecain as "mass destruction." Open-pit mining entails what the name suggests, in that it removes large areas of ground with copper in general and isolates the metal later in the smelting and refining process. This method of copper extraction had large upfront costs and was especially conducive to concentrated, capitalist control. In the United States, the Anaconda, Kennecott, Calumet and Hecla, and Phelps Dodge became the major copper producing firms, with few others playing a prominent role in the industry.[52] This concentration emerged from the large fixed costs of the industry.

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[49] Harkins, William D. (William Draper), 1873-1951, and Robert E. (Robert Eckles) Swain. *Papers On Smelter Smoke, [acute Arsenical Poisoning]*. [s.l., 1908, 37.
[50] Walker, *The Copper Mines of Butte And the Amalgamated Copper Company*.
[51] "Striking Facts of Copper and Its Use," *The Sunday News Tribune* Nov. 15 (1908): 6.
[52] Joseph, *Commodity Frontiers and Global Capitalist Expansion*, 223.

Although these mining endeavors often required large initial investments, profits for the capitalists were significant, clearing over 50% of gross profit in a typical year in Butte.[53] These barons entered a class similar to that of the railroad magnates of the era, a class of elites associated with extreme economic and political power. Mr. Rogers, a leader of the Amalgamated Copper Company, expressed the sentiment that "the copper craft, that it will in the future carry a heavier class of capitalists and float in waters much closer to railroad and other choice investment securities."[54] Despite this high economic standing, copper barons never received the fame and recognition of their railroad counterparts. This is in part due to the mysticism of copper in US society.

To further gain control of the industry and larger portions of the general US economy, copper companies vertically integrated multiple aspects of the copper production process. Copper mines in the US that extracted raw copper ore, for example, also owned their own smelters to refine it into pure metal products.[55] A report of the Baltic Mining Company in Michigan states "We are the selling agents for our own copper production and should be in sufficient funds to carry this copper from the time it is produced until it is sold, delivered, and paid for."[56] In 1917, the Anaconda Copper Company erected their own mill to manufacture the refined copper from their smelters into the finished product of copper wire for export. They additionally owned mills to retain and distribute the phosphate extract from the mines that could be sold in the fertilizer industry.[57] In these ways, copper companies gradually gained greater control over the entire copper network and supply chain.

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[53] Walker, *The Copper Mines of Butte And the Amalgamated Copper Company*.
[54] Walker, *The Copper Mines of Butte And the Amalgamated Copper Company*, 10.
[55] Joseph, *Commodity Frontiers and Global Capitalist Expansion*, 223.
[56] Baltic Mining Company, et al.. *Annual Report*. Boston, Mass, 10.
[57] "Anaconda Copper Plans to Enlarge Operation Excavation for New Wire and Rod Plant Already Started Brass Manufacture Expected," *The Duluth News Tribune* July 8 (1917): 6.

Central to this process of class-making and distinctions was the global market and demand for copper. Price fluctuations had extreme effects on these mining capitalists' fortunes. Notable steel baron Andrew Carnegie noted that metals were "either prince or pauper."[58] In 1903, copper prices hovered around 12 cents per pound, and copper mine owners had to struggle to avoid bankruptcy. In 1906, the price had risen to 25 cents, and anybody with a significant claim in copper was soon a millionaire. Just one year later, prices bottomed back out to 12 cents.[59] The instability of global copper supply and prices led to uncertain class dynamics within the mines and in larger US society.

Japan exhibited similar developments with an emerging elite class of mining industrialists. Following the Meiji Restoration and the transition to modern industrial society, the Japanese mining industry functioned as a foundation for establishing concentrated wealth within an elite few. Those who controlled and profited from copper mining in Japan came to be known as the *zaibatsus*, and they had large control over industry, finance, and trade in the Japanese economy. Lecain notes that the power of these *zaibatsus* made "vast economic empires that went far beyond mining."[60] In this sense, the copper industry of Japan served as a starting point in developing a class of industrial elites that would come to exert power over the entire Japanese political economy. One of the most notable of these men was Furukawa Ichibei, known as the "Mining King of East Asia."[61] Along with other elites, Ichibei helped facilitate a transition in the Japanese mining industry from individually managed to corporately organized around 1900.[62]

[58] "Striking Facts of Copper and Its Use," *The Sunday News Tribune* Nov. 15 (1908): 6.
[59] "Striking Facts of Copper and Its Use," *The Sunday News Tribune*, 6.
[60] Lecain, *The Matter of History*, 275.
[61] Nimura, *The Ashio Riot of 1907*, 24.
[62] Nimura, *The Ashio Riot of 1907*, 24.

Similar to the domestic concentration of capital and wealth in US and Japanese copper, the global copper industry concentrated in the same manner. While rich deposits existed in parts of the global south, the primary capitalists extracting and profiting from these sources were agents of the industrial north. As copper extraction increased, this Euro-American control of copper in developing countries only exacerbated international inequity.

4.2 Labor Dynamics

Naturally stemming from capitalist concentration were many issues and conflicts with the labor power that extracted copper itself. These tensions often culminated in violent strikes and legal battles, all of which argued over the extent to which workers and capitalists should obtain value. Speaking to the Ludlow Massacre in Colorado as a result of a coal mine strike, Thomas Andrews refers to this as the "desperate struggle between Labor and Capital over who would bear the burdens and reap the rewards of American industrialization."[63] This two-way battle constantly raged and evolved over the period from 1880 to 1920. These tensions consistently underlie and support the alleged advance of society brought on by modern technology.

In the copper industry specifically, multiple major strikes occurred that had profound effects on the finished copper market. In 1913, mine workers of the Michigan copper district went on strike for 8 months to improve their wages and working hours. Five local unions and over 9000 members of the Western Federation of Miners voted in 98% support of a referendum to "sell their labor collectively [...] the possibilities of shortening the working day, raising wages, and making some changes in the working conditions," in terms of the manner with which managers treated laborers.[64] This strike had important implications for the copper mining

[63] Thomas G. Andrews, *Killing for Coal: America's Deadliest Labor War*. (Harvard University Press, 2010), 4.
[64] United States. Bureau of Labor Statistics. *Bulletin of the United States Bureau of Labor Statistics.* Washington, D.C.: G.P.O., 19131935.

industry, as it put over 14,000 laborers out of work. Eventually, riots ensued in the district to ensure nonunion members would not be able to work. Michigan Governor Woodbridge Ferris called in 2600 National Guard members to maintain order, and 16 people were ultimately injured.[65] In the annual report of the Baltic Mining Company, General Manager F.R. Bolles explains "The revenues for the year, while better than the previous year, were far from normal, as the first months were affected by the miners' strike."[66] In 1912, workers went on strike at the Bingham Pit in Utah, which led to a small-scale war with state militia. Workers also struck at the Bisbee mines in Arizona in 1917.[67] These strikes had tangible effects on the production process, and implicitly the consumption of copper technologies as well.

Major battles over copper labor control also ensued in Butte, forming in the political arena. In 1900, a competitive campaign took place between two major mining factions in Montana. One group was funded and dominated by the Anaconda Mining Company and their collective interests. The other party was called the "Heinze Democratic Party," and among many reforms called for a standardized 8-hour workday in the copper mines. This campaign exhibited the emerging power struggle between capitalists and miners, and had widespread interest, as written in the *Boston Financial News*: "The outcome of the Montana election will be watched for with much interest by New York and Boston People who own copper stocks."[68] These localized battles had wide-reaching effects on the entire modern network due to the centrality of copper in this emerging system.

Yet again, Japan exhibited these same conflicts and power struggles between mining elites and laborers. In 1914, *The Anaconda Standard* reported the Ashio mine "has been worked

[65] Bureau of Labor Statistics, *Bulletin of the United States Bureau of Labor Statistics.*
[66] Baltic Mining Company, et al.. *Annual Report*. Boston, Mass, 44.
[67] Joseph, *Commodity Frontiers and Global Capitalist Expansion*, 236.
[68] Walker, *The Copper Mines of Butte And the Amalgamated Copper Company*, 32.

continuously for more than 300 years and seems to be destined to wear out many generations of men before its productive days are over."[69] At this time, Japan employed 11,000 miners, and each was paid only 40 cents a day, equivalent to 10 dollars in current terms. Mining corporations also hired girls to work as ore pickers, and they only received 10 cents for a day's work, suggesting a gendered divide in mining.[70] The Ashio mine specifically operated on a piece-rate system, where miner's wages were linked directly to their output, compelling them to maximize their effort and production.[71] This labor exploitation facilitated the collectivization of mine labor, and brotherhoods and miner craft guilds formed throughout Japan.[72]

Eventually, these tensions also culminated in major strikes. In 1907, workers at the Ashio mine went on strike and the conflict violently developed into what became known as the Ashio Riot. This triggered a series of anti-industrial movements across the country and pressured the state to make changes. Ultimately, the biggest adjustment made was an increased policing and supervision of mine workers, so labor conditions in many respects did not improve.[73] Again in 1919, 6,000 Japanese miners went on strike for a 150% wage increase.[74]

Part of these capitalist-worker tensions emerged from downward pressure on wages that were in turn caused by fluctuations in global copper prices, which made corporate balance sheets especially precarious.[75] Mine workers felt the effects of global markets in a way that most people did not before. In the wider global context, copper facilitated the further exploitation of labor,

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[69] "Comes from Japan Study Mining Here. Japanese Mine Manager Who Has Visited Butte Before," *The Anaconda Standard* July 31 (1914): 8.
[70] "Comes from Japan Study Mining Here. Japanese Mine Manager Who Has Visited Butte Before," *The Anaconda Standard*, 8.
[71] Nimura, *The Ashio Riot of 1907*, 35.
[72] Nimura, *The Ashio Riot of 1907*, 39.
[73] Nimura, *The Ashio Riot of 1907*, 203.
[74] "Jap Miners Strike for Pay Increase." *Salt Lake Telegram* Dec. 15 (1919): 2.
[75] Nimura, *The Ashio Riot of 1907*, 208.

allowing for reliable light at nighttime and extending working hours at meathouses, steelworks, and other factories.[76]

These interactions between workers and owners in copper mines did have tangible effects. Owners were cognizant of the costly effects of an unstable labor force and enacted measures in efforts to retain workers. As is written in the Metallurgical American Institute of Mining, "Copper cannot be conducted efficiently when the labor turnover is large. Frequent changing of personnel is costly in any business; but the evils are emphasized when the organization is large."[77] US Western copper corporations invested significantly in recreational amenities such as golf courses, baseball fields, tennis courts, and playgrounds, as a means to promote a stable community for mine workers.[78] These practices evolved into what became known as "welfare capitalism," where copper employers provided amenities such as housing, water, sewage, and schooling to limit strikes and work stoppages.[79]

While retaining a more stable workforce, measures such as these further increased the hegemony of already powerful mining institutions. At the Ashio mine in Japan, workers lived in a lodge system that provided housing, food, and community. Miners even received their work pay from a "lodge boss" who was essentially the landlord of the tenement.[80] This increasing control and regulation of work life in mining camps drastically altered social life, often in stark opposition to the bustling metropoles powered by copper.

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[76] Robert J. Gordon, *The Rise and Fall of American Growth: the U.S. Standard of Living Since the Civil War*. (Princeton, N.J: Princeton University Press, 2016), 267.
E. P. Thompson discusses the evolving relationship between humans and time with the emergence of industrial capitalism in "Time, Work-Discipline, and Industrial Capitalism." *Past & Present*, no. 38, 1967, pp. 56–97. *JSTOR*.
[77] Parsons, *The Porphyry Coppers*, 561.
[78] Parsons, *The Porphyry Coppers*, 561.
[79] Joseph, *Commodity Frontiers and Global Capitalist Expansion*, 237.
This relates closely to the culture of "Fordism" developed by Henry Ford in his mass production of motor vehicles and treatment of employees.
[80] Nimura, *The Ashio Riot of 1907*, 37.

5.1 Environmental Engagement

In similar ways to labor exploitation, the mass increase in the market for copper led mining capitalists to further increase their exploitation of the environment as well. Mining in general was a process that engaged extensively with ecology and nature. It diverted streams and waterways to erode mineral veins, cut timber to thaw the ground, and took apart and reassembled terrain around discoveries. Beyond the mining of copper itself, the refining and smelting process had an extremely profound effect on the environment. Smelting copper ore involves burning off the various combined metals and elements and emitting these damaging gases into the atmosphere. This had caustic effects on nearby animals, plants, and land.

Copper transported modern information and power in such a mystifying manner that consumers of these modern technologies were largely unaware of the environmental damage that went into the support of such a system. The Metallurgical Institute of Mining described "All that is needed to convey electric power is a copper wire. Where adequate water is available it can be generated at coal mines, in the oil or gas fields, at hydroelectric plants, and distributed everywhere."[81] Gas, coal, and water all indirectly powered the growth and prosperity of urban centers, but they traveled there from the hinterlands via seemingly inconspicuous copper wires.

Robert Gordon describes this phenomenon specifically with electricity: "The arrival of electricity moved the pollution from the inside of the home to the outside, for the generation of electricity from coal-fired plants sent carbon emissions into the atmosphere."[82] In US copper mines, extraction applied significant pressure to environmental constraints. As mentioned previously, the newly revolutionized method of "open-pit" mining completely tore into the

[81] Parsons, *The Porphyry Coppers*.
[82] Gordon, *The Rise and Fall of American Growth*, 116.

ground and produced immense amounts of waste during extraction and smelting.[83] One report on the Anaconda copper mine stated that "Hundreds of tons of sulphur are volatilized and pass off in gas through their stacks every day."[84] The mine also had a constant fire running to refine copper ore for 11 years consecutively by 1908.[85] The mine also had a huge demand for timber, consuming about a million feet each month.[86]

Pollution around the Anaconda Copper Mine reached a level so severe that farmers in the Deer Lodge Valley Farmers' Association sued the company for damages of 2.3 million dollars.[87] The litigation necessitated a scientific report into the conditions of the mine titled "The Determination of Arsenic and Other Solid Constituents of Smelter Smoke, with a Study of the Effects of High Stacks and Large Condensing Flues." This report found the smelter smoke from the Anaconda refinery to be harmful to nearby plant and animal life as well as soil. The main source of damage was from the arsenic emitted into the air during the refining process, which would combine with water in clouds and dump acid rain into nearby lands. The sulphuric acid destroyed vegetation and killed horses and cows. The evidence against the Anaconda was scientifically definitive.

Despite these findings, the US Circuit Court Judge hearing the case determined that no verdict could be made. This appears puzzling with the provided evidence, but within the context of copper power in the Montana political economy, the verdict becomes more intelligible. The Anaconda Mining Company's tax payments accounted for 30% of the entire state's revenue.[88]

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[83] Timothy J. Lecain, *Mass Destruction: The Men and Giant Mines that Wired America and Scarred the Planet*. New Brunswick, (N.J: Rutgers University Press, 2009), 14.
[84] Harkins, *Papers On Smelter Smoke*, 12.
[85] Harkins, *Papers On Smelter Smoke*, 14.
[86] Harkins, *Papers On Smelter Smoke*, 14.
[87] Harkins, *Papers On Smelter Smoke*, 946.
[88] Harkins, *Papers On Smelter Smoke*, 28.

Additionally, much of the larger economy in the region relied either directly or indirectly on the business of the copper mines. One account provided in the deposition speaks to this importance:

> The city of Anaconda has grown until it now has a population of about twelve thousand. This city owes its growth and prosperity to the conduct of the smelting business at the Washoe smelter, and its population is dependent on subsistence, directly or indirectly, upon the continued operation of the smelter [...] The people living there have made their investments, believing that the smelting works would continue to operate, and, as would be natural, the products of Deer Lodge Valley, - hay, vegetables, garden truck, grain, alfalfa livestock and other farm products, - have generally found ready market at good prices in Anaconda.[89]

The dependency of modernity on copper and its coordinated environmental degradation is linked closely here. Plants, land, and animals must suffer and endure for industrial society to enjoy mass networks of electrification and telecommunication. These tensions between cattle ranchers, farmers, and copper miners in Montana maintained for many years, in what would eventually be termed the "Montana Smoke War."[90] Agricultural and industrial interests continue to be pitted against each other in present society.

Japan experienced extremely similar circumstances in terms of environmental exploitation by the copper industry. Ever since the 6th century CE, Japan had a fairly productive mining industry, and those interests were constantly at odds with developing agriculture.[91] Farming interests were relegated even further to the periphery as Japan transitioned into a modern, industrializing nation. The Ashio copper mine, being the largest of its kind in the nation, also had the most widespread polluting effects, so much so that it was deemed "Japan's first industrial pollution disaster."[92] Much like the Anaconda, the Ashio emitted sulphuric clouds that

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[89] Harkins, *Papers On Smelter Smoke*, 28.
[90] Timothy J. Lecain, "Copper and Longhorns: Material and Human Power in Montana's Smelter Smoke War, 1860–1910." In *Mining North America: An Environmental History since 1522*, edited by McNeill J. R. and Vrtis George, 166-90. (Oakland, California: University of California Press, 2017), 167.
[91] Lecain, *The Matter of History*, 255.
[92] Nimura, *The Ashio Riot of 1907*, 5.

infected the nearby Watarase River and subsequently reduced rice yields.[93] *The Morning Oregonian* reported on these developments in 1902, stating

> [The Ashio copper mine] has been affecting thousands of acres of once fertile land [...] ruining the crops, poisoning domestic animals, and undermining the health of a large population [...] one commission, which numbered among its members some of the oldest scientists in Japan, has already sent in a report which discusses the existence at Ashio of an awful state of things.[94]

These environmental damages aroused strong opposition in the Japanese farming community. Families protested the smelting practices of the Ashio mine, in powerful opposition to the central government's guidelines on industrializing the nation. The leader of this countermovement, Tanaka Shōzō, even petitioned the emperor for relief.[95] Unlike their American counterparts, these Japanese activists implemented ethical and ideological arguments about the role of a farm and industrialization, rather than direct legal or economic battles. Shōzō, for example, often argued that the true power of Japan lies not in its industry, but in its agricultural products.[96]

Regardless of their strategy, the caustic effects of copper mining were clear. Lecain describes the eradication of a community near the Ashio mine due to environmental damage: "A village that had been continuously occupied for more than six centuries became a ghost town, emptied of all human and most other forms of life."[97] It was in these explicit channels that environmental change brought about by copper extraction had direct effects on the human network.

5.2 The Urban/Rural Divide

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[93] Nimura, *The Ashio Riot of 1907*, 20.
[94] "Poisoned by Copper. Japanese Mining District Being Decimated by the Deadly Mineral." *Morning Oregonian* July 4 (1902): 4.
[95] Nimura, *The Ashio Riot of 1907*, 20.
[96] Lecain, *The Matter of History*, 247.
[97] Lecain, *The Matter of History*, 266.

As is evident in the cases of both the US and Japan, the copper network propelled forward the prosperity of cities, which became the image of a modern industrialized nation, while rural hinterlands came to bear the negative externalities of such a system. This became a distinct feature of the "commodity frontier," defined by Jason Moore as a "process of appropriation, exploitation, dispossession, and ecological fragmentation."[98] Speaking more to this disproportionate burden, Sabrina Joseph writes that commodity frontiers "resulted in uneven development between core and periphery, town and countryside."[99] Through copper specifically, American and Japanese cities exploded in prosperity at the cost of many rural areas.

Advertisements and newspapers in the US at this time pushed images of progress and growth in city life, citing the newfound electrical appliances of washers, ironers, dryers, refrigerators, vacuum cleaners, sewing machines, fans, heaters, and much more to improve the standard and quality of living.[100] Even by 1922, however, 79% of US farmers continued to use kerosene in place of electricity. Women on farms were estimated to work 13.12 hours per day, much more than their urban counterparts who were aided by electrical tools.[101] Even by 1940, 96% of urban areas in the US had access to electricity, while only 78% of small towns, 31% of farms, and 16% of southern farms did.[102] Telephone access also heavily favored urban over rural homes.[103] These disparities affected a significant portion of the US population, as the share of rural America remained above 50% until 1920.[104] In conjunction with all of the environmental

[98] Joseph, *Commodity Frontiers and Global Capitalist Expansion*, 2.
[99] Joseph, *Commodity Frontiers and Global Capitalist Expansion*, 1.
[100] "Woman's Daily Magazine Page - Electricity in the Home Appliances for Electricity Are Built in Homes," *Albuquerque Morning Journal* June 19 (1922): 5.
[101] "Woman's Daily Magazine Page-Electricity in the Home Life of Women in City Easier by Electricity," *Albuquerque Morning Journal* Apr. 17 (1922): 5.
[102] Gordon, *The Rise and Fall of American Growth*, 120.
[103] Gordon, *The Rise and Fall of American Growth*, 182.
[104] Gordon, *The Rise and Fall of American Growth*, 97.

effects damaging crops, plants, animals, and land, rural areas were pushed farther and farther into the periphery of modern industrial society.

6.1 Global Implications

Elsewhere globally, the interactions between industrialized and developing countries surrounding copper exhibited these same inequities in modern technological access. From roughly 1945 to 1970, foreign capitalists dominated Chilean copper mines, including British and Australian financiers, but especially American corporations, who had interests in 87% of total Chilean copper output.[105] William Braden of the Braden Copper Company, for example, was an American who infused an immense amount of technology and expertise into the developing Chilean copper mines.[106] The African copper belt, stretching roughly from the Belgian Congo to Northern Rhodesia, also experienced similar foreign control, particularly from European imperialists.[107] These imperial nations also became the primary benefactors of copper ores, to the benefit of their own growing technology, while developing countries continued to be pushed toward the periphery.

6.2 Current Events

These injustices even persist in current events. India, one of the world's fastest industrializing nations at the current moment, continues to have significant portions of rural areas without access to electricity. As of 2014, 17% of Indian rural households still lacked access to electricity, which accounts for 163 million people.[108] The Indian government has made efforts to

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[105] Vergara, Angela. *Copper Workers, International Business, and Domestic Politics in Cold War Chile*. (University Park, PA: Pennsylvania State University Press, 2008).
Joseph, *Commodity Frontiers and Global Capitalist Expansion*, 225.
[106] Joseph, *Commodity Frontiers and Global Capitalist Expansion*, 193.
[107] Joseph, *Commodity Frontiers and Global Capitalist Expansion*, 216.
[108] Anshuman Gupta and Narendra N. Dalei. *Energy, Environment and Globalization: Recent Trends, Opportunities and Challenges in India*. (Singapore: Springer, 2020), 123.

bring electricity to these areas, as it would significantly raise the standard of living there. While more access is being reached, the program has in many ways failed, and has also brought into discussion other industrialized countries and the implications of such widespread environmental pressure. The average American produces 16 times the carbon emissions of an Indian, and as of 2008, India emitted only 4.6% of the world's greenhouse gasses, while making up 17% of the world population.[109] A movement toward electrification in Indian hinterlands can have unintended consequences for the environmental outlook of the world. Rajendra K. Pachauri, chairman of the Intergovernmental Panel on Climate Change, exemplified these anxieties, stating "India cannot emulate developed countries. We have to find a distinctly different path."[110] The interplay of these current complex issues around electrification implicitly surrounds copper, whose distribution makes possible the widespread use of fossil fuels.

7.1 Commodified Copper

The discourse on negotiating the endeavors of mining and farming provides insight into the perception of commodities in modern society. In the case between the Deer Lodge Valley Farmers' Association and the Anaconda Mining Company, Judge Marshall posited a very crucial question: "Can both industrial and agricultural welfare be preserved under the exigencies of the whole case before us?"[111] This remains an important question when considering the structure of our modern envirotechnical network, and how much priority should be given to technology in exchange for the preservation of ecology. As human networks continue to place pressure on food production with other endeavors, they increase the pressure on our collective survival.

[109] Sengupta, Somini. “Thirsting for Energy in India's Boomtowns and Beyond.” *The New York Times*, The New York Times, 2 Mar. 2008, www.nytimes.com/2008/03/02/world/asia/02india.html.
[110] Somini, “Thirsting for Energy in India's Boomtowns and Beyond.”
[111] Harkins, *Papers On Smelter Smoke*, 37.

While the effects of copper mining discussed herein only appear to affect these rural hinterlands, they threaten the very agricultural system that all human life is dependent upon. William Cronon speaks in *Nature's Metropolis* of the tendency in scholarly and popular works to partition the city and country when they take part in one, integrated system.[112] He writes of this obscuring aspect as the following: "If we concentrate our attention solely upon the city, seeing in it the ultimate symbol of man's conquest of nature, we miss the extent to which the city's inhabitants continue to rely as much on the non-human world as they do on each other."[113] Missing this connection fails to show the profound importance of copper extraction's effects. When land, plants, and animals are damaged and even killed near copper refinery smokestacks, it affects not only that area itself but the entire human network that connects to and uses that system.[114] The ecological change copper production enacts will come to affect all of industrial society through these channels, as well as the relationship between the global north and south.

Similarly, tracing copper production and extraction has complicated the entire notion of modern industrial progress. Popular understandings of electricity, railways, and telephones depict modern society as a bustling, fast-paced, and efficient world. Tracing the processes that helped support these modern innovations, particularly in the extraction of copper, reveals that the enjoyment of these industrial networks comes at the cost of human and environmental exploitation, as well as global inequality. Even beyond these injustices, new tools have obscured as much as they have uncovered truths about our existence and place in the world. For almost all of human history, people have been able to look up and see the shape of the Milky Way Galaxy

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[112] William Cronon, *Nature's Metropolis: Chicago and the Great West*. (W.W. Norton, 1997), xiv.
[113] Cronon, *Nature's Metropolis*, 18.
[114] As Timothy Lecain writes in *Mass Destruction*, "It is precisely that disconnect between human products and the environmental source of raw materials - between what we label "technology" and what we label "nature" - that needs to be closed if we are to better comprehend the dynamics of the modern world." Lecain, *Mass Destruction*, 9.

in the starry night sky. In most populated areas in the modern day, the sky glow from artificial lighting has obstructed this view, and humans are no longer able to be humbled in this profound way. As Japanese conservationist leader Shōzō put it most eloquently, "Electricity is discovered and the world is darkened."[115]

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[115] Lecain, *Matter of History*, 290.

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