5 Guano

The global metabolic rift and the fertilizer trade

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The appropriation of resources from distant lands for commerce and war has long been part of human civilization and has been associated with various forms of environmental degradation. However, since the late fifteenth century, capitalism has been the hegemonic economic system, influencing social relationships, transforming landscapes, and shaping patterns of material exchange. It is a system predicated on the constant accumulation of capital. Its internal laws propel it forward, subsuming the world to the logic of capital – all the while generating contradictions and divisions. Capitalist expansion determines relationships of exploitation, ecological degradation, and unequal ecological exchange. While the specific forms and manifestations of these conditions depend upon the historical context and the demands of economic production, the ecologically unsustainable nature of the capital system is evident in how it employs land, resources, and labor in the accumulation process.

Ecological degradation is influenced by the structure and dynamics of the world capitalist system, whereby a single world economy is divided into numerous nation-states, competing with one another directly and via their corporations. Nations occupy fundamentally different positions in the international division of labor and in the world system of dominance and dependency. The transfer of economic values in the accumulation process also involves material–ecological flows that transform ecological relations between regions, especially the core and periphery. Control of monetary and material exchange generates social and environmental inequalities. Stephen Bunker (1985) examined how the extraction and export of natural resources from periphery countries involved the vertical flow of not only economic value, but also energy and matter to developed countries. These trade arrangements, influenced by the dynamics of the global economy and positions within the world-system, negatively affected and undermined the socio-ecological conditions in extractive countries. In other words, core capitalist nations compensate for the degradation of their own environments through the even more rapacious exploitation of the natural resources of periphery countries, creating an "environmental overdraft" that benefits the former at the expense of the latter (Elvin 2004: 470; Hornborg 2003; Jorgenson 2006).

In this chapter we employ metabolic analysis to consider how the unsustainable practices of capitalist agriculture produce environmental problems that

generate global asymmetries in the exploitation of the environment and contribute to unequal ecological exchange. In what follows, we present the metabolic character of capital. We detail how the metabolic rift in the nutrient cycle in Britain and other capitalist states in the nineteenth century led to the rise of the international fertilizer trade in guano. We then discuss the guano rush and the trade of this prized fertilizer. We also examine the exploitation of land and labor that accompanied this trade.

Capitalism, metabolism, and metabolic rifts

The concept of metabolism was established within both chemistry and biology in the early nineteenth century for studying the chemical processes within organisms and the biological operations of organisms. It captures the complex biochemical processes of exchange, through which an organism draws upon matter and energy from its environment and converts these by various metabolic reactions into the building blocks of growth. The metabolism concept allowed scientists to document the specific regulatory and relational processes that direct interchange within and between systems – such as organisms digesting organic matter. Marx incorporated this concept, but in a much broader context, into all of his major political-economic works, using it to analyze the social metabolism of the capital system and, by extension, the dialectical interchange between humans and their environment. By necessity there is a "metabolic interaction" between humans and the earth, as the latter supports life. Through the labor process, humans transform the world and themselves. For Marx (1975: 209), labor is "an eternal natural necessity which mediates the metabolism between man and nature, and therefore human life itself." Such a conception is two-sided. It captures both the social character of labor, associated with such metabolic reproduction, and its ecological character, requiring a continuing, dialectical relation to nature.

Marx's conception of the metabolic process conforms to modern science. As the great physicist Erwin Schrödinger (1945: 71–72) wrote in *What Is Life?*:

> How does the living organism avoid decay? The obvious answer is: By eating, drinking, breathing and (in the case of plants) assimilating. The technical term is *metabolism*. The Greek word … means change or exchange. Exchange of what? Originally the underlying idea is, no doubt, exchange of material.

Marx's metabolic analysis viewed socio-ecological systems as dependent for their regeneration upon specific metabolic processes involving complex historical relationships of interchange and reproduction (Foster 2000). Natural systems, such as the nutrient cycle, have their own metabolism, which operate independently of and in relation to human society. Due to the interpenetration of society and nature, humans have the potential to alter the conditions of life in ways that undermine the reproduction of natural systems. Each mode of production imposes a particular system of labor and exchange that shapes the society–nature relationship.

In assessing actual metabolic interactions, Marx examined the constantly evolving set of needs and demands that arose with the advent and development of the capitalist system, which transformed the social interchange with nature, directing it toward the constant pursuit of profit. He highlighted this change in *A Contribution to the Critique of Political Economy*, explaining that

> the exchange of commodities is the process in which the social metabolism, in other words the exchange of particular products of private individuals, simultaneously gives rise to definite social relationships of production, into which individuals enter in the course of this metabolism.
>
> (Marx 1972: 51–52)

Use of the concept of metabolism here was meant to draw attention both to the metabolic exchange between nature and humanity – the underlying condition of human existence – and also to the reality of social metabolic reproduction. The latter expresses the fact that social formations as organic systems have to be seen as continuing and developing processes. They therefore need to be analyzed in terms of the totality of the relations of exchange (and relations of social production/reproduction) that constitute them. The constant reproduction of capital on an ever-larger scale intensifies the metabolic demands on nature, necessitating new social relations and forms of socio-ecological exchange. As capital subsumes the world to its logic of accumulation, due to the persistent pursuit of profit, it runs roughshod over the regulatory processes that govern complex relationships of interchange within natural systems and cycles (Mészáros 1995).

Capitalism, as a social metabolic order, produces various global inequalities and ecological contradictions. Marx (1976: 915) detailed how the process of primitive accumulation during the rise of capitalism as a global economy established divisions between the core and periphery, as the wealth of distant lands was appropriated and transferred to core nations using various forms of labor exploitation, such as slavery. In its drive to constantly expand and replenish itself, capital seeks to overcome whatever social and natural barriers it confronts (Marx 1993: 409–410). It often transforms landscapes in one location to further capital accumulation, only to exhaust the desired resources, before moving to another location to repeat the same process. As a result, distant lands, ecosystems, and labor become mere appendages to the growth requirements of the advanced capitalist center. For Marx, England, as the leading capitalist country at the center of a world-system, was "the metropolis of landlordism and capitalism all over the world" drawing on the resources of the globe. A whole nation like Ireland could be turned into "mere pasture land which provides the English market with meat and wool at the cheapest possible prices" (Marx and Engels 1972a: 290–292). Nothing so demonstrated this unequal ecological exchange in the nineteenth century as the international guano trade that arose to compensate for the "environmental overdraft" that characterized industrial agriculture in Europe and the United States.

In order to understand the emergence of the international fertilizer trade, it is necessary to present how industrial agriculture in Britain and other nations

created an environmental problem – the depletion of soil nutrients – for which guano was deemed a solution. In the 1840s, Germany's leading chemist, Justus von Liebig, along with other agricultural chemists and agronomists, sounded the alarm with respect to the loss of soil nutrients – such as nitrogen, phosphorus, and potassium – through the transfer of food and fiber to the cities. Rather than being returned to the soil to replenish it, as in traditional agricultural production, these essential nutrients were shipped hundreds, even thousands, of miles and ended up as waste, polluting the cities and waterways.

John Chalmers Morton (1859), who studied the application of mechanical power in agriculture, noted that agricultural improvements increased the uniformity of land, making it easier to increase the scale of operations and to employ industrial power within agricultural operations. Marx (1976: 497–498) was a devoted student of Liebig's work and studied Morton when writing *Capital*. He incorporated a metabolic analysis into his critique of political economy, indicating that an economic system premised on the accumulation of capital led to intensive agricultural practices to increase the yield of food and fiber for markets. Just as this system had imposed a division of labor, it simplified natural systems and created divisions within nature, within natural cycles. Thompson (1968) indicates that during this transformation of agriculture, farmers increasingly had to purchase inputs – due to the loss of nutrients – to maintain operations. In this, farming increasingly took the form of "a manufacturing industry," which increased the "intensity of cultivation" (Thompson 1968: 64). Marx (1991: 950) lamented how capitalism degraded labor and nature under these conditions:

> Large-scale industry and industrially pursued large-scale agriculture have the same effect. If they are originally distinguished by the fact that the former lays waste and ruins labour-power and thus the natural power of man, whereas the latter does the same to the natural power of the soil, they link up in the later course of development, since the industrial system applied to agriculture also enervates the workers there, while industry and trade for their part provide agriculture with the means of exhausting the soil.

The accumulation process and the division between town and country influenced the transfer of nutrients and the conditions of the soil. Marx (1976: 637) pointed out that capitalist agriculture

> disturbs the metabolic interaction between man and the earth, i.e. it prevents the return to the soil of its constituent elements consumed by man in the form of food and clothing; hence it hinders the operation of the eternal natural condition for the lasting fertility of the soil.

In other words, a metabolic rift in the nutrient cycle was created under these productive relations, which squandered of the riches of the soil, undermining the everlasting nature-imposed conditions of human existence.

Horrified by the scale of soil degradation, Liebig (1859: 130–131) exclaimed,

> Truly, if this soil could cry out like a cow or a horse which was tormented to give the maximum quantity of milk or work with the smallest expenditure of fodder, the earth would become to these agriculturalists more intolerable than Dante's infernal regions.

He explained that British high farming (early industrialized agriculture) looted the soil of its nutrients. Upon exhausting its soil nutrients, Britain then sought to compensate for this by robbing other countries of the means needed to replenish their own soil. He wrote:

> Great Britain deprives all countries of the conditions of their fertility. It has raked up the battle-fields of Leipzic, Waterloo, and the Crimea; it has consumed the bones of many generations accumulated in the catacombs of Sicily…. Like a vampire it hangs on the breast of Europe, and even the world, sucking its lifeblood without any real necessity or permanent gain for itself.
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> (Quoted in Mårald 2002: 74)

Marx, too, referred to the imperialist exploitation of the soil nutrients of whole countries – developing out of the metabolic rift in the nutrient cycle. "England," he observed, "has indirectly exported the soil of Ireland, without even allowing the cultivators the means for replacing the constituents of the exhausted soil" (Marx 1976: 860). As capitalism expanded, increasingly importing food and fiber from abroad, so did the metabolic rift. Marx (1976: 579–580) indicated that capitalist growth serves the interests of the "main industrial countries, as it converts one part of the globe into a chiefly agricultural field of production for supplying the other part, which remains a pre-eminently industrial field." In this, the abuse and "misuse" of "certain portions of the globe … depends entirely on economic conditions" (Marx 1991: 753).

The degradation of the soil in core nations hastened the concentration of land among a smaller number of proprietors, who adopted even more intensive methods of production, including the mass importation of manures and eventually the application of artificial fertilizers. For Marx (1991: 949), capitalist agriculture, and by extension capitalism in general, created an "irreparable rift" in natural cycles. Successive attempts to address the soil nutrient problem, moreover, transformed this into a global metabolic rift resulting from the disproportionate transfer of matter and energy from the periphery to the core. Put differently, in order to compensate for the effects of their robbing of their own soil, European nations and the United States sought to rob other countries of their soil nutrients, creating a global metabolic rift.

The guano trade

In the nineteenth century, the guano trade brought together China, Peru, Britain, and the United States in a system of extreme resource and human exploitation that stretched across the entire capitalist world economy. Guano was deemed a

precious commodity that would help replenish lost soil nutrients in advanced countries. The international guano trade is tied to soil depletion in the core, the advance of soil science, the transformation of landscapes, the transfer of human populations, the exploitation of nature and peripheral nations, and the integration of the global economy. It highlights the environmental overdraft that contributed to European prosperity while hiding the extent of the ecological degradation of industrial capitalism.

The existence and use of guano as fertilizer had been known for centuries in Europe, but its importance to European and US agriculture was not immediate, given the particular economic conditions and the state of agricultural science. In 1604, an English translation of Father Joseph de Acosta's book, *The Natural and Moral History of the Indies*, was published. De Acosta (1880: 281) detailed how important the seafowl and guano were to the indigenous population of Peru:

> In some Ilands and headlands, which are ioyning to the coast of Peru, wee see the toppes of the mountains all white, and to sight you would take it for snow, or for some white land, but they are heapes of dung of sea fowle which seems but a fable. They [the indigenous peoples] go with boates to these Ilands onely for the dung, for there is no other profit in them. And this dung is so commodius and profitable as it makes the earth, yeelde great aboundance of fruite. They cal this dung Gauno, wherof the valley hath taken the name, which they call Lunahuana in the valleys of Peru, where they vse this dung, and it is the most fertile of all that countrie.

In the seventeenth century, the use of guano for agriculture was a subject of endless fascination. However, advances in the science of soil chemistry, specifically the nutrient relationship between soil and plants, did not occur until the nineteenth century.

At the beginning of the nineteenth century, the German explorer Baron Alexander von Humboldt observed how Peruvian farmers used guano to enrich their dry farm lands (Skaggs 1994). He took samples of guano back to Europe in 1803, but there was no drive then to study this particular substance. However, as soil depletion intensified, so did the need for fertilizers, stimulating business interests in the potential application of guano. In the 1820s, tests were conducted to assess the chemical composition of guano in comparison to the requirements of plants and the nutrients lost through crop production. Guano contained high concentrations of phosphate and nitrogen. In 1835, a few cases of guano were imported to Great Britain to test the dung on crops. Guano proved to be a powerful fertilizer. The possibility of high returns seemed promising, given that the increase in yields surpassed what was calculated as the likely costs of guano importation.

Advances in soil science furthered interest in guano. In 1840, Liebig published *Organic Chemistry in its Application to Chemistry and Physiology*, detailing how modern farming practices and the division between town and country contributed to the loss of soil nutrients. In the same year, Alexandre Cochet, a French scientist, discovered that valuable quantities of nitrate of soda could be

extracted from guano and nitrates (saltpeter), both of which were abundant in Peru, helping stimulate the rush for guano (Skaggs 1994). Guano was soluble, so it was fast-acting, and provided an immediate influence on the growth of plants. The problem of soil degradation in Britain and the United States sparked the international guano rush, as agriculturalists sought the precious fertilizer to compensate for the soil nutrients they were losing.

Peru had the largest deposits of high-quality guano. Its guano contained the highest concentration of nutrients that were useful to crops. It rarely rained on the coast of Peru, and as a result the nutrients in the guano were not washed away, as they were on other islands and coasts throughout the world. The mountains of guano that de Acosta described were on the Chincha Islands off the coast of Peru. These islands served as a habitat to numerous species of sea birds. The ocean currents surrounding these islands created an upflow of decayed matter, sustaining a massive population of anchovies, which the birds ate and deposited as waste on the rocks. The anchovy diet greatly enriched the usefulness of the dung produced by the birds. The guano deposits, hundreds of feet deep, had accumulated over thousands of years (Peck 1854).

In the 1840s, Peru was still in debt to Britain for monies borrowed during the fight for independence from Spain. Guano offered an avenue for Peru to meet its debt payments and gain foreign exchange through the sale of guano contracts. Lima was at the time the richest city in South America. Although there were a number of contracts between the Peruvian government, acting on behalf of the Lima oligarchy, and European businesses (primarily British, but also French) during the duration of the guano trade, which thrived for 40 years, the dominant trade agreement was between Lima and the British firm Anthony Gibbs & Sons. The company holding the contract with the government had exclusive rights over the sale of guano on the global market. As a result, Britain dominated the global guano trade.

The government of Peru claimed ownership of the guano (Mathew 1972, 1977, 1981). Peruvian subcontractors, who were granted contracts from the government, were placed in charge of the digging and loading process. Lima repeatedly renegotiated the Peruvian guano contracts, trying to get a better deal. In addition to receiving a specified amount of money per ton of guano shipped, the government borrowed money against the contracts. Much of the money made via the sale of guano was directed toward paying off the existing and accumulating debt taken out by the Lima oligarchy, in a classic case of imperial dependency.

In 1841, the first full cargo of guano arrived in Britain. The manure was quickly sold on the market, stimulating interest to secure more guano. An advertising campaign was conducted to promote the use of guano. Gibbs & Sons (1843) published *Guano: Its Analysis and Effects*, which collected the stories of farmers who tested guano fertilizer on their crops. These accounts detail the various techniques of guano application and the results, praising the powers of guano to make plants grow taller, stronger, and more productive. Claims were made that the soil was richer, as the nutrients were retained for several crop

rotations. While this book served as a marketing ploy, its conclusion was clear: increased yields could be obtained using a "cheap" fertilizer. Other publications tested guano against other fertilizers, employing Liebig's work on the loss of soil nutrients (Sheppard 1844; Smith 1843; Solly 1843; Trimmer 1843). These tests heralded the triumphs of guano as far as its ability to meet the nutrient needs of crops. Guano became an obsession, seeming to offer an escape from the ecological contradiction that had been created.

Marx (1976: 348) noted that the "blind desire for profit" had "exhausted the soil" of England, forcing "the manuring of English fields with guano" imported from Peru. Industrialized capitalist agriculture had fundamentally changed the nutrient cycle. Agriculture was no longer "self-sustaining" as it "no longer finds the natural conditions of its own production within itself, naturally, arisen, spontaneous, and ready to hand" (Marx 1993: 527). Britain was not the only country confronting severe losses in soil nutrients. Farms in upstate New York and plantations in the southeastern United States were in desperate need of powerful fertilizers (Genovese 1967). Thus, both merchants and agriculturalists from Britain and the United States sought the fertilizer to compensate for the soil nutrients they were losing (Skaggs 1994).

Given the British trade monopoly on Peruvian guano supplies, the United States pursued imperial annexation of any islands thought to contain guano deposits. In 1856, Congress passed the Guano Islands Act, allowing capitalists to seize 94 islands, rocks, and keys around the globe between 1856 and 1903 (Skaggs 1994). "In the last ten years," Liebig observed in 1862, "Britain and American ships have searched through all Seas, and there is no small island, no coast, which has escaped their enquiries after guano." But, in the end, the deposits on the islands of Peru were the best, given the ideal natural conditions to preserve the nutrients.

For 40 years, Peru remained the most important country for meeting European and North American fertilizer needs. During this period, millions of tons of guano were dug, loaded, and shipped from Peru. In 1850, Britain imported over 95,000 tons of guano (Mathew 1968: 562–579). The following year, almost 200,000 tons were imported; by 1858, over 302,000 tons. From 1863 to 1871, the imports per year ranged from 109,000 tons to 243,000 tons. As noted above, guano was not only exported to Britain; from 1866 to 1877, Peru exported between 310,000 and 575,000 tons per year to the world as a whole, helping enrich stressed soils (de Secada 1985: 597–621).

The Chincha Islands, with deep guano deposits, were a site of constant activity. In the early 1850s, a British officer reported witnessing the simultaneous loading of guano on 100 ships, representing 11 different countries, primarily from the United States and Europe, from a single island off the coast of Peru (Dennis 1931; Farcau 2000). Additionally, hundreds of other large ships would be waiting at sea for a turn to be loaded ("Guano Trade" 1856; Nash 1857).

Despite the millions of tons of guano that were exported from Peru, international demand could not be met. Inferior guano deposits on islands throughout the world were mined and sold on the market. Off the African coast, an island

with substantial guano deposits had 460 ships on one day, simply waiting to fill up with the cargo. In a short period of time, the "island [was] reduced to nothing but a plateau of bare rock" (Craig 1964: 35–37). The guano trade suffered setbacks, as inferior guano was packaged and sold with false labels, claiming it was Peruvian guano. Farmers became leery of guano on the market, but the necessity for fertilizer remained, given the metabolic rift in the nutrient cycle.

The guano trade transformed Peru in a number of ways. In the early 1800s, silver was the primary export of Peru. After Peru's independence, Britain quickly forged trade relations, importing wool and cotton. While Peru desired trade protection, Britain worked to reduce tariffs and duties, desiring free trade. Once the guano trade was established, this resource became the primary export commodity. Guano supplied 5 percent of state revenue in 1846–1847. In 1869 and 1875, 80 percent of state revenues came from the guano trade (Bonilla 1987: 225). The terms of trade continued to decline, as Peru was forced into accepting liberal policies which favored metropolitan capital in the imperial states (Hunt 1973). The export economy failed to help the domestic economy. The Lima oligarchy spent money on luxury items, rather than social development, on paying interest on loans, and on the building of rails. At the same time, much of the infrastructure of the country, such as its irrigation systems and roads, fell into disrepair (Duffield 1877). It was dependent on foreign nations for general commodities.

During this period, Peru was plagued by the resource curse. It had the most treasured fertilizer in the world, which was needed by core capitalist nations, but Peru remained in debt to bondholders. The Peruvian ruling class profited heavily from the guano trade. Some of the money was used to help rich landowners enlarge their sugar and cotton operations. In particular, Domingo Elías, who handled contracts related to the extraction of guano, purchased more land and extended his plantation operations. He helped transform the agricultural sector into a producer of cash crops (such as cotton and cochineal) for export to Europe and the United States, transferring the riches of the soil to more developed nations (Blanchard 1996; Gorman 1979). Liebig and Marx noted that through incorporation into the global capitalist market and long-distance trade, the earth was robbed of its richness, the soil was depleted of its nutrients, and the separation between town and country increasingly became international. These conditions and consequences were only exacerbated through the exportation of guano and the production of cash crops, increasing the global metabolic rift. In spite of this trade, Peru remained a country in debt and one with vanishing resources.

The guano trade transformed the natural landscape of Peru, especially the islands where guano was mined. In *Peru in the Guano Age*, A.J. Duffield (1877: 89), who took measurements to estimate the remaining guano deposits, describes the changes that had taken place:

> On my return from the south [part of Peru] we passed close to the Chincha islands. When I first saw them twenty years ago, they were bold, brown heads, tall, and erect, standing out of the sea like living things, reflecting the light of heaven, or forming soft and tender shadows of the tropical sun on a

> blue sea. Now these same islands looked like creatures whose heads had been cut off, or like vast sarcophagi, like anything in short that reminds one of death and the grave.

The guano deposits that took thousands of years to accumulate were being depleted. Boussingault (1845: 290), a French soil scientist, noted that since guano had become "a subject of the commercial enterprise of mankind" its reserves were quickly disappearing. The rate of extraction was faster than the rate of natural accumulation. To make matters worse, the prospect for additional excrement was questionable, given that the extraction of guano was executed without regard to the needs of the birds, which were driven away and/or slaughtered in some cases (Murphy 1925: 55–56). The natural fertilizer that had been used for hundreds of years in Peru was being exported and diminished, as the social metabolic order of the capitalist world-system expanded.

Chinese coolies and guano extraction

The guano trade not only involved the shipping industry and the distribution of manure on fields, but also necessitated a labor regime to extract the materials from the islands. In the pursuit of profit, both Peru and Britain contributed to the global movement and exploitation of labor. In the 1840s Peru had a labor shortage for its plantations and mines. The government passed "an immigration law subsidising the importation of contract labourers" (Gonzales 1955: 390–391). Anyone who imported "at least fifty workers between the ages of 10 and 40" was paid 30 pesos per head. Exploiting decades of social disruption due to the Opium Wars and the Taiping Rebellion in China, European merchants began the systematic transfer of Chinese laborers to Cuba and Peru (Hu-DeHart 1989, 2002). Through coercion, deceit, and even kidnapping – often by the same individuals and companies who had engaged in the slave trade – tens of thousands of Chinese "coolies" were contracted for through Macao and Hong Kong (Clayton 1980; Hu-Dehart 1989). The voyage by ship (otherwise known as a "floating coffin") to Peru took approximately five months. During this passage, the Chinese coolies were provided with a meager ration of rice. The mortality rate during the first 15 years of the trade was 25–30 percent. To escape the horrible conditions, some Chinese in passage "jumped overboard [if and when allowed on deck] to put an end to their sufferings" (Wingfield 1873: 4). Marx and Engels characterized the labor of "Indian and Chinese coolies" as "disguised slavery," and they reveled in stories of "the very coolies" on ships destined for the Americas and elsewhere rising "in mutiny," as happened a number of times during passage (Marx 1963: 112; Marx and Engels 1972b: 123).

The first Chinese coolies or indentured manual laborers arrived in Peru in 1849. Between 1849 and 1874, over 90,000 Chinese coolies were shipped to Peru. Around 9,700 died during passage (Gonzales 1955: 390–391). The majority of coolies worked on the sugar and cotton plantations and built the railroads. However, many were forced to work on the guano islands. Of the three realms of

employment, the guano islands had the worst labor conditions. For many years, Domingo Elías held the contract for operating the extraction of guano. He employed coolies, but also used convicts, army deserters, and slaves to work the guano islands. The work force on these islands varied through the years, but often involved between 200 and 800 individuals.

The extraction of guano required digging into mounds of excrement that covered rocky islands. The capital outlay for extraction was minimal. The most expensive items were the bags into which guano was loaded. Using picks and shovels, coolies were required to dig through the layers of guano, filling sacks and barrows. Each worker had to load 80–100 barrows each day. Once the barrows were filled, the workers hauled the guano to a chute to transfer it to the ships. If the workers failed to move between two to five tons during the day, they were physically punished. On occasion over 20,000 tons were said to be extracted from the islands in a day ("Guano Trade" 1855; Mathew 1977; Nash 1857).

George W. Peck (1854: 207) visited the islands and noted that the Chinese were "over-worked beasts of burden," forced to "live and feed like dogs." The guano islands, he stressed, "seem to me to be a kind of human *abattoir*, or slaughter-house of men" (Peck 1854: 204). The emaciated bodies of the workers struggled to carry sacks of guano and to push the barrows. A visitor to the islands pointed out that: "The poor coolies have no hope or reward, no days of rest … what a hell on earth these islands must be" ("Chincha Islands" 1854). Acrid dust penetrated the eyes, the noses, and the mouths of workers. The stench was appalling, and sometimes overwhelmed workers. Duffield (1877: 77–78) noted:

> No hell has ever been conceived by the Hebrew, the Irish, the Italian, or even the Scotch mind for appeasing the anger and satisfying the vengeance of their awful gods, that can be equalled in the fierceness of its heat, the horror of its stink, and the damnation of those compelled to labour there, to a deposit of Peruvian guano when being shoveled into ships.

Infractions by workers were met by severe punishment, such as flogging, whipping, or being suspended for hours in the sun. Some workers were branded on the cheeks with hot irons. Suffering from an inadequate diet, physical cruelty, and the inability to escape from the stench of the guano, many Chinese committed suicide by jumping off the cliffs and into the ocean. Peruvian employers attempted to stymie revolt by working with the British to import opium to pacify Chinese workers ("Chincha Islands" 1854; Clayton 1980; Hu-Dehart 1989: 108–109; Wingfield 1873: 5).

Although coolies were not legally slaves, they lived in de facto slavery or worse. As prisoners, unable to leave the islands, they received minimal monetary returns. They lived in barracks that were guarded by armed men (Wingfield 1873: 5). In an account of the Chincha Islands, Alanson Nash (1857) noted that "Once on the islands [a coolie] seldom gets off, but remains a slave, to die there." The cruelty imposed upon the Chinese laborers was inseparable from

reports regarding the guano trade. The coolies were driven as expendable beasts: "As fast as death thins them out, the number is increased by new importations" of coolies who are thus "sold into absolute slavery – *sold by Englishmen into slavery* – the worst and most cruel perhaps in the world" ("Chincha Islands" 1854). Working under the whip, the cruelties were "scarcely believable, and very few, if any, of the Chinese survived more than a few months." Workers would fall "exhausted and dying by the side of the shute through which the fertilizer was passed into the hold of the vessel" ("Chinese Coolie Trade" 1862: 221). "Those Chinese who did not commit suicide by some means or other speedily succumbed to overwork, breathing the guano dust, and a want of sufficient food" (Lubbock 1955: 35).

The connection between the fertilized fields of Britain and the exploitation of Chinese workers did not escape the British consciousness. Writing in *Nautical Magazine* in 1856, a correspondent observed that the powers of guano as a fertilizer were well known,

> but few probably are aware that the acquisition of this deposit, which enriches our lands and fills the purses of our traders, entails an amount of misery and suffering on a portion of our fellow creatures, the relation of which, if not respectably attested, would be treated as fiction.
>
> ("Chincha Islands" 1856)

The *Morning Chronicle* wrote that the conditions of labor on the guano islands "seems to realise a state of torment which we could hardly have conceived it possible for man to enact against his fellow man" (Mathew 1977: 44). The *Christian Review* ran a story about the Chinese coolie trade, noting that "the subtle dust and pungent odor of the newfound fertilizer were not favorable to inordinate longevity," creating a constant demand for more workers, given that guano labor involved "the infernal art of using up human life to the very last inch" ("Chinese Coolie Trade" 1862). For Marx, writing in the *New York Daily Tribune* on April 10, 1857, Chinese coolies were being "sold to worse than slavery on the coast of Peru" as a result of British imperialism (Marx and Engels 1972b: 106). Even some shipmasters, upon delivering their cargo of coolies in 1854, were "horrified at the cruelties they saw inflicted on the Chinese, whose dead bodies they described as floating round the islands" (Wingfield 1873: 5).

Despite public outrage regarding the treatment of the Chinese coolies on the guano islands and attempts to end the coolie trade, British merchants continued to transport "hundreds of thousands of … indentured servants to British colonies" around the world (Gonzales 1955: 391). Ironically, in Peru, the success of the guano trade and the cheapness of importing Chinese coolies as workers made it possible for slavery to be abolished in the 1850s. Coolies were simply acquired to replace the freed slaves. Slaveholders, such as Elías, who pushed to pass a bill that would subsidize the importation of Chinese laborers, were compensated for the loss of the slaves that were now free. At the same time, Elías and other businessmen profited from the importation of coolies.

The labor process on the guano islands was quite simple, depending primarily on human labor to make the guano useful. In order to sustain the large profits and control over the workers, the process was not modernized. Despite the millions of tons of guano that were being exported from Peru, international demand could not be met. The asymmetrical movement of natural resources – the unequal ecological exchange of resources – to meet imperial interests was intimately connected to the exploitation of human labor under inhuman conditions.

Conclusion

Intensive, industrial practices in agriculture, along with the divide between town and country, created a metabolic rift in the nutrient cycles in core countries. In order to enrich the soil in Britain and other core nations, an international trade in guano was established, transferring millions of tons of this powerful fertilizer from Peru to the global North. In this "environmental overdraft" the metabolic rift was extended to the global level, as fertilizer and agricultural goods – as well as the soil nutrients embodied in the food and fiber – were transferred to urban centers within the core. Imported labor from China worked as "beasts of burden" mining the guano. These workers were physically beaten and lived short lives to enrich the soils of distant lands. The international fertilizer trade ushered in decades of civil unrest, war, debt, and ecological degradation. Given the global asymmetries in the international hierarchy of nations, the resource curse accompanied this prized commodity. As guano supplies dwindled, nitrates served as the new fertilizer, creating conflict and war between Peru and Chile, which resulted in the British exercising greater control over this vital resource (see Clark and Foster 2009). The Haber–Bosch process that produces ammonia through the fixation of nitrogen allowed artificial fertilizer to be produced on an industrial scale shortly before World War I. This new industry undermined the international trade of guano and nitrates. As a "technological fix" (see Clark and York, this volume), it increased the industrialization of agriculture, without attending to the source of the metabolic rift in agriculture.

Capitalism's endless pursuit of profit continually worsens environmental conditions and presses against ecological boundaries. The worst forms of degradation, as well as the pillaging of resources and the disruption of sustainable relations to the earth, are concentrated in the periphery. Unequal ecological exchange, an outcome of the global metabolic rift, has allowed for the growth of the center of the system at unsustainable rates. The global metabolic rift in the nutrient cycle is simply one manifestation of the ecological problems generated by the social metabolic order of capital. To mend the ecological rifts requires revolutionary transformations in our metabolic relation to nature, surmounting the logic of capital in order to pursue a sustainable social order.

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