CHARLES UNIVERSITY IN PRAGUE
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Plastic in Nature: Understanding Plastic and its Socio-historical Context

Master's Diploma Thesis

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Supervisor: Mgr. Karel Černý, Ph.D.

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I hereby declare that I have written this diploma thesis solely by myself and I agree with its eventual publication in print or electronic form. All sources and literature have been properly cited. The work has not been used to obtain a different or the same degree.

Prague, May 5th, 2023 Ian Francisco Morell

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Abstract

This article explores the proliferation of plastic in the modern era, especially as it relates to nature. Using the text *The Ecological Rift* along with *Capitalism in the Web of Life*, this article first attempts to understand the nature-society dialectic and how capital relations have produced changes in natural systems and vice versa. Then, using the texts *Land of Desire* along with *American Plastic: A Cultural History*, this article contextualizes the productive and cultural relations which underpin plastic production and its eventual fate as pollution. Finally, this article concludes with an attempt to synthesize these texts to understand plastic pollution as a world-transforming phenomenon with long-term, uncertain effects.

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The earth, that was so lately rude and formless,
was changed by taking on the shapes of men.
-Ovid, *Metamorphoses*

Part 1: Introduction

In the 1980s, people living off the northwest coast of France in Brittany began noting a strange occurrence. Plastic, orange telephones shaped like a cartoon cat, had begun to wash up continuously onto the shore without any apparent source.[1] The remnants varied from plastic cat visages, disembodied and eyeless, to fully intact cat phones. Locals would clean the beaches of the plastic-cat refuse in a Sisyphean effort as the pieces continued to wash up onto shore for decades. The mystery of their source lasted for more than thirty years.

Jim Davis 'Garfield comic became nationally syndicated in the late 1970s, which started Garfield the character's rise to a recognizable pop-culture figure. The titular orange tabby cat, characterized by his all consuming laziness, remains beloved to this day. *Garfield's* popularity under the auspices of mass consumer culture went hand in hand with intensive merchandising—merchandising that included telephones created in his image. Due to an apparently mishandled and subsequently lost shipping container, plastic Garfield phones became a fixture at certain French beaches. The lost shipping container answers the question of *what happened* without elucidating the real *how* and *why.* The mechanism and science behind invasive growths of natural phenomena such as the red tides produced by algal blooms lend themselves more easily to analysis. The *how* and *why* of algal blooms are matters of positivist investigations using the scientific method—there is little, if any, mystery. On the other hand, the invasion of plastic Garfield phones poses thornier problems for investigation. First, one must make sense of the underlying historical formations which made

[1] Palko Karasz, "Why Do Garfield Phones Keep Washing Up on This Beach?," *The New York Times*, March 29, 2019, https://www.nytimes.com/2019/03/29/world/europe/garfield-phones-france.html.

the mass production of plastic orange cat phones both possible and logical—i.e., what specific relations of production and consumption exist between modern society and nature that would result in an invasion of plastic phones on French beaches.

1.1 Defining Plastic and its Limits

An investigation into the relations of production under capitalism which have led to the ever increasing production of plastic must first begin with identifying precisely what one means when referring to plastic. Plastic exists under a large variety of forms, brand names, uses, and production processes that prove hard to pin down for analysis. Jeffrey Meikle touches on this in the introduction to his seminal work *American Plastic: A Cultural History*. He writes, "It is hard to do justice to plastic because it serves so many functions, assumes so many guises, satisfies so many desires, and so quickly recedes into relative invisibility…".[2] The mass-produced one-time-use plastics of general social ire, like drinking straws, look far different from the plastic Teflon coating used to make cooking pans non-stick. Both are distinct from the synthetic polymers of Nylon used for military parachutes. Formica tables, Bakelite radios, inflatables, synthetic polymers mirroring silk, Plexiglass, Tupperware—the endless varieties obscure the heart of what makes plastic, as its generally understood, plastic. Meikle continues in a similar vein: "…soft waxy vinyl of raincoats shared few properties with the dull hard Bakelite of distributor caps, the tough transparent acrylic of aircraft enclosures, or the brittle polystyrene of children's toys."[3] The perspective of climate scientists involved with quantifying ecological crises helps clarify what falls under the moniker of "plastic."

[2] Jeffrey Meikle, *American Plastic: A Cultural History* (New Brunswick: Rutgers University Press, 1995) Kindle ebook, loc 81.

[3] Ibid, loc 184.

Planetary boundaries, an idea coined by Swedish environmental scientist Johan Rockstrom and his team refer to the nine interlinked chemical and physical processes by which the earth reproduces the conditions of the geological epoch known as the Holocene. A crossing of these boundaries attempt to quantify the earth's growing inability to reproduce the conditions of the Holocene.[4] These boundaries include climate change (measured in carbon dioxide concentrations), the rate of biodiversity loss (measured in extinction rate), the nitrogen and phosphorous cycles, changes in land use, ocean acidification, ozone depletion, global freshwater use, atmospheric aerosol loading, and finally, chemical pollution. According to their metrics, when the article, "A Safe Operating Space for Humanity" was first published in 2009, climate change, the rate of biodiversity loss, and the nitrogen cycle had crossed their boundaries,[5] while metrics for chemical pollution had yet to be decided on. According to their paper, the purpose of identifying quantifiable boundaries was "to identify the Earth-system processes and associated thresholds which, if crossed, could generate unacceptable environmental change."[6] The proliferation of plastics falls under the yet-to-be quantified boundary of chemical pollution.

In 2022, the American Chemical Society published a report from a team of environmental scientists led by Linn Persson of the Stockholm Environment Institute titled: "Outside the Safe Operating Space of the Planetary Boundary for Novel Entities." Since the original publication of the boundary analysis, chemical pollution has been reconfigured and is

[4] Johan Rockstrom et al., "A Safe Operating Space For Humanity," *Nature*, September 23, 2009, https://www.nature.com/articles/461472a.

[5] Ibid.

[6] Ibid.

now referred to as the introduction of "novel entities"[7] into the environment. In their article, Persson et al. both defined a boundary for the introduction of novel entities into the earth system and found that said boundary has been crossed. Novel entities are defined "as new substances, new forms of existing substances, and modified life forms that have the potential for unwanted geophysical and/or biological effects."[8] Novel entities refer to more than just plastics, including the introduction of heavy metals and chemicals into the environment. The concern over the introduction of novel entities is summarized as such:

> "…the anthropogenic introduction of novel entities to the environment is of concern a the global level when these entities exhibit persistence, mobility across scales with consequent widespread distribution and accumulation in organism and the environment, and potential negative impacts on vital Earth System processes or subsystems."[9]

Plastic pollution has presented climate scientists with a unique challenge. As "new substance under the sun,"[10] the method for establishing control variables based on historical climate data under the Holocene, like those calculated for carbon dioxide emissions, are not applicable.[11]

[7] Linn Persson et al., "Outside the Safe Operating Space of the Planetary Boundary for Novel Entities," *Environmental Science & Technology* 2022, 1510-1521

[8] Ibid.

[9] Ibid.

[10] Jeffrey Meikle, *American Plastic: A Cultural History,* loc 128

[11] Linn Persson et al., "Outside the Safe Operating Space of the Planetary Boundary for Novel Entities."

A prior study from Stockholm University from researchers Patricia Villarrubia-Gomez, Sarah Cornell, and Joan Fabres proposed a sub-boundary within the novel entities group focused solely on marine plastic pollution. The spread and scale of marine plastic pollution in conjunction with deep uncertainty surrounding long-term effects, make analyzing plastic's ecological impact difficult. The study confirms that "…the Earth-system effects of plastic are irreducibly complex, with poorly predictable environmental behavior, fates and interactions with other chemical substances—both natural and synthetic."[12] The study focuses on three key criteria for determining if marine plastic pollution constitutes a sub-boundary including reversibility, whether the effects are only detectable at a planetary level, and whether there is a disruptive effect on Earth-system processes. The biggest uncertainty lies in the last point, but Villarubia-Gomez et al. point to a variety of possible Earth-system risks from marine plastic pollution. While they find that "[the] ubiquity of plastic debris and the unfeasibility of its substantial removal from the marine environment…mean that exposure is essentially irreversible,"[13] the actual effects of this irreversibility and accumulated plastic pollution remain uncertain. They point to possibilities of marine plastic pollution affecting the ocean's ability to sequester carbon, its effect on the ocean's biogeochemical nutrient flows, effects on marine's life ability to reproduce, food-chain disruptions, and plastic acting as a host to invasive algal blooms, viruses, and bacteria.[14]

The scientific discussion surrounding planetary boundaries investigates effects while leaving underlying causes mostly undisturbed. The language introducing Persson et al.'s

[12] Patricia Villarubia-Gomez, Sarah Cornell, Joan Farbes, "Marine Plastic Pollution as a Planetary Boundary Threat," *Marine Policy* 96, October 2018, 213-220

[13] Ibid.

[14] Ibid.

abstract regarding the boundary for novel entities begins as such: "We submit that the safe operating space of the planetary boundary of novel entities is exceeded since annual production and releases are increasing at a pace that outstrips the global capacity for assessment and monitoring."[15] Here, the underlying issue is very lightly touched on—production. Plastic must come from somewhere and be produced in such a volume as to possibly affect the Earth-system as a whole, then there must be a determining logic behind its mass proliferation. While Jeffrey Meikle's *American Plastic* will later provide this article with a historical footing for understanding plastic, John Bellamy Foster, Richard York, and Brett Clark's *The Ecological Rift: Capitalism's War on the Earth* along with Jason W. Moore's *Capitalism in the Web of Life: Ecology and the Accumulation of Capital* provide frameworks for understanding the interactions between nature and society and how they may be reaching a crisis point.

1.2 Aims and Method

Both Foster et al. and Moore revisit Marx with ecology in mind. They each redeploy these newly focused concepts to examine the dialectical interactions of society and nature. While the ontological foundations of their analysis are easy to pose in opposition to one another, this paper examines how their conclusions complement one another quite well especially as it relates to contextualizing the modern proliferation of plastics. This article utilizes their concepts along with Meikle's indispensable *American Plastic: A Cultural History* to better understand the plastic industry's inception and subsequent transition from producing niche, durable objects with utopian aspirations to mass producing disposable

[15] Persson et al., "Outside the Safe Operating Space of the Planetary Boundary for Novel Entities."

plastics with massive throughput. Specifically, this article will use a method of comparative review to better illuminate plastic's place in modernity.

Part 2: Literature Review

This literature review examines in-depth sociologist John Bellamy Foster's reintroduction of Karl Marx's concept of the "metabolic rift" and how he relates it to Earth's current ecological circumstances. According to Foster, Marx's concept of the metabolic rift refers to a rift between humanity and nature due to "…the expansion and intensification of the social metabolic order of capital [which] generates rifts in natural cycles and process, forcing a series of shifts on the part of capital, as it expands environmental degradation."[16] Beginning with the theoretical foundation Foster uses to claim historical materialism as inherently ecological, this review then discusses Foster's concrete examples of metabolic rifts in the natural metabolism between man and nature including the nutrient cycle of soil (which Marx also discussed) and the carbon cycle to better lay the foundations for a metabolic analysis of plastic. Also included for analysis are the key ideas that flesh out Foster's redeployment of Marx's metabolic rift, such as the Anthropocene, the Jevons Paradox, the treadmill of accumulation, and constructive-realism. Additionally, this literature review examines a response to Foster's rift analysis from sociologist Jason W. Moore in his book *Capitalism in the Web of Life: Ecology and the Accumulation of Capital*. While their differences and apparent opposition will be examined, their complementary character proves more useful to contextualizing plastic. Moore's concepts of Cheap Nature, frontiers of appropriation, negative value, and ecological surplus can be assimilated into a metabolic analysis of plastic production.

[16] John Bellamy Foster, Brett Clark, Richard York, *The Ecological Rift: Capitalism's War on the Earth* (New York: Monthly Review Press, 2010) Kindle ebook, loc 1109.

2.1 How Foster Draws on Marx

Foster insists upon the already deeply ecological character of traditional Marxian analysis. His purpose in espousing, updating, and popularizing Marx's notion of metabolic rift is to "rediscover…certain neglected methodological foundations of classical historical materialism," and to "[develop] an ecological materialism organically connected to historical materialism itself."[17] In his 1999 work Marx's Ecology: Materialism and Nature, Foster's goal is to reveal the inherently ecological nature of Marx's work. To support this assertion, Foster grasps onto Marx's notion of alienation. Marx identifies four types of worker alienation under capitalism which notably includes man's alienation from his or her act of production.[18] Foster is then able to take this form of alienation to necessarily imply an alienation from nature which he highlights with a quote from Marx's *Grundisse*: " Labour is, first of all, a process between man and nature, a process by which man, through his own actions, mediates, regulates and controls the metabolism between himself and nature."[19] By this conceptualization, man's alienation from production necessarily constitutes an alienation from nature. Foster confirms this line of thinking, writing: "It follows that alienation is at one and the same time the estrangement of humanity from its own laboring activity and from its active role in the transformation of nature."[20] Foster ties together Marx's more explicitly conceived concept of man's alienation from labor with his concept of man's alienation from nature by showing that, in alienating himself from his production, man necessarily alienates himself from nature. In uniting these strands of thought, Foster finds alienation from nature to

[17] John Foster, Brett Clark, *Marx and the Earth* (Leidin: Brill, 2016), pdf ebook, 10.

[18]John Foster, *Marx's Ecology* (New York: Monthly Review Press, 2000), pdf ebook, 107.

[19] Karl Marx, *Grundisse* 527 quoted in John Foster, "Marx's Ecology", 218.

[20] John Foster, *Marx's Ecology*, 108.

be an already important if underemphasized point in Marx's analysis of the capitalist mode of production.

According to Foster, part of the reason Marxism needed this ecological re-understanding was due to the work of early Marxian scholars such as Georg Lukács rejecting the notion that the dialectical method could be applied to nature in a meaningful way. For Lukács, because knowledge of nature is socially mediated, a dialectical analysis cannot be complete or useful due to the intrusion of positivist natural facts into the realm of social theory.[21] Foster makes reference to the "Lukács' Problem" which at once claims Marx's dialectical method as improper for analyzing nature while admitting that there exist objective dialectics of nature (positivist facts) which do indeed matter.[22] Foster confronts this analysis writing: "Materialism, like the dialectic, related only to society and was narrowed down to an abstract concept of economic production…[in] rejecting dialectical materialism, Western Marxism rejected materialism (and with it nature) rather than the dialectic, attempting to find a way to define Marxism exclusively as a dialectic of social praxis."[23] Foster's work here presents a continued attempt to validate man and nature's relationship as a proper field for dialectical analysis. He criticizes Lukács' thinking for, as he sees it, falling into an idealistic notion of human social metabolism that wrongly de-emphasizes the metabolic, dialectical relationship between man and nature. For Foster, and according to his analysis of Marx as well, nature cannot be relegated to a field of just positivist facts. There are relations to be analyzed. Further validating Foster's own project, Marx himself explicitly discusses the idea

[21] John Foster et al, *The Ecological Rift*, loc 3639.

[22] Ibid, 224.

[23] Ibid, 226.

of a metabolic rift not just in terms of social production, but in terms of a rift between nature and man.

Marx's discussion of the nutrient cycle in soil presents Foster with his most obvious theoretical foothold for claiming Marx's method as inherently ecological. According to Foster, Marx's concept of the metabolic rift draws heavily from the works of Scottish thinker James Anderson—works in which Anderson tries to uncover the origins of differential rent prices for soil.[24] Anderson's analysis shows that human labor can result in soil improvement or degradation which "…accounted for differential rent—and not the conditions of absolute fertility[.]"[25] This contention that human action affects nature and vice-versa even in the short run of historical time flies in the face of Lukács' conception of nature as a realm of unchanging facts. Anderson preempts and ostensibly inspires Marx with the conclusion that "the growing division between town and country had led to the loss of natural sources of fertilizer."[26] This social metabolic rift between town and country arose due to a rift between man and nature; nutrients necessary for the reproduction of crops in the country are wasted as, put simply, city waste. The other influential thinker of Marx's ecological thinking was soil chemist Justus von Liebig who uncovered the chemical role nutrients play in crop growth.[27] Liebig's chemical investigations can be summed up in a parable from his Letters on Modern Agriculture, which is quoted at length here:

[24] John Foster, *Marx's Ecology*, 201.

[25] Ibid, 202.

[26] Ibid.

[27] Ibid, 209.

"Now, supposing this same land falls into the hands of ten great proprietors, the pillage and plunder system then takes the place of the system restitution and compensation… the large proprietor…sends his grain and flesh for sale to the great centres of consumption, and accordingly loses the conditions of their reproduction. After a number of years the land place in this position will be turned into a desert waste like Roman Campagna." [28]

In Foster's conception, the interconnection between Anderson's work and that of soil chemist Justus von Liebig gave Marx the foundation to historicize and incorporate nature into his work culminating in his concept of metabolic rift. [29]

Marx explicitly discusses the rupture between man and nature in Capital. Quoting Marx via Foster, Marx writes, "Capitalist production…concentrates the historical motive force of society; on the other hand, it disturbs the metabolic interaction between man and the earth…"[30] The alienation of man from the product of his labor thus necessarily means, at least the in the case of crops as commodities, an alienation of man from his metabolic relationship with nature. Foster confirms this assertion by again quoting Marx's *Capital*: "[The labor process] is the universal condition for the metabolic interaction between man and nature, the everlasting nature-imposed condition of human existence."[31] Labor mediates and expresses the metabolic interaction between man and nature which leaves room for a rift in that interaction due to the capitalist mode of production. In Grundisse, Marx makes his case

[28] Justus Liebig, John Blyth, *Letters on Modern Agriculture* (New York, 1859), pdf ebook, 186.

[29] John Foster, *Marx's Ecology*, 204.

[30] Karl Marx, *Capital Vol. 1*, page 637-8 quoted in John Foster, *Marx's Ecology*,216.

[31] Karl Marx, *Capital Vol. 1*, page 290 quoted in John Foster, *Marx's Ecology*,218.

of a metabolic rift clear: "…the se*paration* between these inorganic conditions of human existence and this active existence…is completely posited only in the relation of wage labor and capital."[32] Using these various points of emphasis, Foster now has a theoretical basis to utilize Marx's idea of metabolic rift in his analysis of earth's current ecological condition and its connection to the capitalist mode of production.

2.2 Ecological Rift and the Carbon Cycle

In *Ecological Rift: Capitalism's War on The Earth*, Foster, along with sociologists Richard York and Brett Clark take Marx's concept of metabolic rift as he related it to soil and use it to explore earth's current ecological condition. The book explains, "Marx's analysis, although primarily related to the nitrogen and phosphorus (also potassium) cycles, can be seen as a key to the whole problem of planetary boundaries."[33] These planetary boundaries refer to certain natural thresholds which, when violated, would irrevocably disrupt earth's ecology. In the introduction to their book, Foster et al. also refer to the influential *Nature* article from Swedish scientist Johan Rockström and his team which details earth's so-called nine planetary boundaries. These are: climate change (measured in atmospheric concentration of carbon dioxide), the rate of biodiversity loss, the nitrogen cycle, the phosphorus cycle, ozone depletion, ocean acidification, freshwater use, land use, the atmospheric aerosol load, and chemical pollution.[34] According to Rockström et al.'s construction, three of these processes have already gone past their boundaries—climate change, the rate of biodiversity

[32] Karl Marx, *Grundisse*, 489 quoted in John Foster, *Marx's Ecology*, 220.

[33] John Foster et al., *The Ecological Rift*, loc 677.

[34] Johan Rockström et al, "A Safe Operating Space for Humanity," Nature, 2009

loss, and the nitrogen cycle.[35] Taking these planetary boundaries as its foundation coupled with Marx's work, *Ecological Rift* points toward the machinations of the capitalist mode of production as the reason these boundaries are being approached or in certain cases passed. They find the three crossed boundaries identified by Rockström et al "as constituting an extreme 'rift' in the planetary system."[36] *Ecological Rift* makes its case for how these rifts arise due to the logic of capitalism.

In keeping with Marx, Foster and his cohorts find the ecological rift to be intimately connected to a social rift inherent to the capitalist mode of production. They write, "This ecological rift is, at bottom, the product of a social rift: the domination of human being by human being. The driving force is a society based on class, inequality, and acquisition without end."[37] They find capital's intrinsic need for continuous accumulation and growth to be antithetical to a material environment with limited resources. As a mode of production, capitalism "determines the interchange between society and nature."[38] In its determinations, the capitalist mode of production encourages the proliferation of exchange-values over so-called use-values. In other words, the exchange value of commodities takes precedence over any use-value to be derived from nature. Foster et al. write, "But political economy was to encompass in its concept of value…nothing but exchangeable value. Nature or public wealth…was to be left out of the account."[39] Where Foster and company see an inherent

[35] Ibid.

[36] John Foster et al., *The Ecological Rift*, loc 134.

[37] Ibid, loc 691.

[38] Ibid, loc 1093.

[39] Ibid, loc 802.

destructiveness in the capitalist mode of production, others hope that the value of nature could be accurately priced in to the production process. Preempting this notion, Foster et al. claim that failing to account for nature's value is a "fundamental contradiction of the regime of capital itself."[40] In other words, a capitalist mode of production that accurately priced in the value of nature cannot exist as it would disrupt the process of capital accumulation. *Ecological Rift's* discussion of the Anthropocene and the carbon cycle make their point clear.

Fundamental to *Ecological Rift*'s premise is the concept of the Anthropocene. The Anthropocene refers to the idea that the earth has exited the Holocene and entered a new geological phase. The Anthropocene as a concept contends that the intensification of human production activity due to industrial capitalism has altered earth's ecology so extensively that it should be considered a geological force on par with something like an ice age. Foster et al.'s analysis extends Marx's concept of metabolic rift in relation to soil nutrients to explain how the dawn of the Anthropocene signals larger, all-encompassing ecological rifts. *Ecological Rift* explains: "The development of the human economy in the Anthropocene has acted as a catalyst for the unprecedented acceleration of changes in the atmosphere, the climate, the ocean, and the Earths's ecosystems."[41] Foster and his cohorts make clear the connection they find between a capitalist world economy and accelerating ecological changes. Specifically, their argument rests on an analysis of earth's faltering carbon cycle (due to the accumulation of carbon dioxide in the atmosphere) and its relation to capital accumulation. Foster et al.'s analysis "draw[s] upon the strength of Marx's metabolic

[40] Ibid, loc 912.

[41] Ibid, loc 489.

analysis for studying the nature-society dialectic"[42] as they "extend its application to examine global climate change, including human influence on the carbon cycle and its consequences."[43] Put simply, *Ecological Rift* attempts to understand the climate crisis as a metabolic crisis arising due to the specific historical circumstances of the capitalist mode of production.

Ecological Rift's evidence of a rift in the carbon cycle comes down to the ever-increasing atmospheric concentration of carbon dioxide. This phenomenon coupled with overwhelmed natural carbon sinks leads to a disruption in the atmospheric balance found in the Holocene. Atmospheric levels of carbon dioxide, measured in parts per million (ppm), have risen to approximately 410 ppm as of 2019.[44] According to Rockstrom's boundary analysis, a carbon dioxide concentration of more than 350 ppm means a boundary has been broken.[45] The consequences of such a break include the "risk of irreversible climate change, such as the loss of major ice sheets, accelerated sea-level rise and abrupt shifts in forest and agricultural systems."[46] Foster along with the general environmental scientific community point to the excessive burning of fossil fuels as the reason behind the growing accumulation of carbon dioxide in the atmosphere and thus the reason for the growing threat of major environmental consequences.[47] Foster et al. then connect the excessive burning of fossil fuels

[42] Ibid, 1791.

[43] Ibid.

[44] Rebecca Lindsey, "Climate Change: Atmospheric Carbon Dioxide," NOAA, https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide, 2020.

[45] Johan Rockström et al, "A Safe Operating Space for Humanity," Nature, 2009.

[46] Ibid.

[47] John Foster et al., *The Ecological Rift*, loc 2072.

with the advent of industrial capitalism and the inherent tendencies of the capitalist mode of production.

Understanding how much of an outlier the concentration of carbon dioxide in post-industrial society is necessitates a discussion of the preindustrial carbon cycle and how it worked with prevailing ecological conditions. *Ecological Rift* summarizes general scientific knowledge stating that stable ecological conditions depend on carbon cycling "through the air, soil, water, and all living things."[48] The carbon cycle, sans industrial interference, occurs through two processes known as the fast and slow carbon cycles.[49] In the slow carbon cycle, chemical reactions move carbon from the atmosphere into rocks through acid rain. The carbon then moves, through erosion, into the ocean and is deposited as shale rock at the bottom of the ocean.[50] Volcanic eruptions then return carbon dioxide to the atmosphere. According to NASA, "Chemistry regulates this dance between ocean, land, atmosphere. If carbon dioxide rises atmosphere…temperatures rise, leading to more rain, which dissolves more rock…that will eventually deposit more carbon on the ocean floor."[51] There exists a cyclical balance in this carbon cycle. The fast carbon cycle describes how carbon flows through living biological organisms such as plants. Through various chemical processes, plants utilize carbon from the atmosphere to make sugars and this carbon is then eventually released back into the atmosphere.[52] According to NASA, "…the carbon dioxide released in

[48] Ibid, loc 1938.

[49] Holli Riebeek, "The Carbon Cycle," NASA Earth Observatory, https://earthobservatory.nasa.gov/features/CarbonCycle.

[50] Ibid.

[51] Ibid.

[52] Ibid.

the reaction usually ends up in the atmosphere. The fast carbon cycle is so tightly tied to plant life that the growing season can be seen by the way carbon dioxide fluctuates Inter atmosphere."[53] Between these two processes, the fast and slow carbon cycles, a predictable balance has been struck within the context of geological time. NASA clarifies that the atmospheric balance is in a continuous, though largely predictable, flux.[54] *Ecological Rift* explores how industrial capitalism has upset that balance through both the excessive burning of fossil fuels and the degradation of natural carbon sinks.

The mutability of atmospheric and ecological circumstances by biological actors (such as humans) is key to this analysis, countering the idea of nature as a static force of immutable facts. By the mid-nineteenth century, scientists such as John Tyndall had begun investigating the link between atmospheric conditions and earth's temperature.[55] Through his scientific experimentation, Tyndall "determined that carbon dioxide and other gases, which make up only a small proportion of gases in the atmosphere, absorbed heat via infrared radiation…[which] helped warm the earth (the 'greenhouse effect') to create a habitable climate."[56] Logically, it follows that all else being equal, a general increase in the atmospheric concentration of carbon dioxide would mean a general increase in world temperatures. The idea that natural conditions could change over not just long durèe geological time but over shorter historical periods became defensible. Foster et al. examine how fantastic changes in the carbon content of the atmosphere occurred over a historical period starting with the advent of capitalism but beginning in earnest after industrialization.

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[53] Ibid.

[54] Ibid.

[55] John Foster, *The Ecological Rift*, loc 1900.

[56] Ibid, loc 1913.

Ecological Rift concedes that any organization of production, capitalist or not, causes changes in natural conditions. However, the speed with which capitalist relations of productions altered, and continue to alter natural ecological cycles is the object of their scrutiny. Foster et al. refer to key mechanisms explaining the capitalist mode of production's culpability in these ecological rifts. One of these factors is the concept of the solar-income restraint. They write: "By mining the earth to remove stored energy (past plants and animals) to fuel machines of production, capitalist production has 'broken the solar-income budget constraint, and this has thrown [society] out of ecological equilibrium with the rest of the biosphere.'"[57] While economic activity outside of a capitalist mode of production has certainly taken advantage of the stored solar energy in long dead plant mass, again, the salient point here is the speed and volume of extraction and use that capitalism encourages. The large-scale burning of fuel upsets the predictability and balance of the carbon cycle seen throughout the Holocene. Industrial capitalism specifically, with its need to fuel machines and ever expanding production, has disrupted the ecological balance of carbon in the atmosphere. Foster et al. summarize their position:

> "The movement from human motive power to water and wind to coal-driven steam engines transformed capitalist production, increasing the scale of production by pushing up labor productivity to historically unprecedented levels, and by deepening the exploitation of nature and labor. The social metabolism with nature was intensified to facilitate the accumulation of capital on an ever-larger scale."[58]

They find that the logic of capital accumulation in concert with new industrial labor practices produced the rift seen in the carbon cycle. Industrial production necessitates ever-increasing

[57] Ibid, loc 2011.

[58] Ibid, loc 1998.

quantities of raw materials from nature without regard for a sustainable metabolic relationship between man and nature. Foster et al write, "Thus it is important to grapple directly with how global climate change is related to the historical era of capitalism, which serves as the background condition influencing social development."[59] Necessary to their analysis of the technology of industrial capitalism and its machinations is the Jevons Paradox.

2.3 Jevons Paradox

Simply stated, Jevons Paradox refers to the phenomenon in which an increase in resources efficiency will cause an overall increase, not decrease, in the consumption of that resource. Jevons Paradox implies that technological improvements to resource extraction and use (especially in the case of carbon) actually deepen ecological rifts produced under capitalism. The concept originated with William Stanley Jevons in his 1865 work *The Coal Question* in which he grimly assesses Britain's consumption of coal in relation to its dwindling cheap supply.[60] While his dire assessment of the British coal situation proved false[61], a notion hidden in his work gained prominence, especially in the years of popular climate concern. Foster et al. write, "Jevons contended that increased efficiency in the use of coal as an energy source only generated increased demand for that resource[.]"[62] The key to this paradox comes down to price. With more efficient machines and resource extraction methods, the price of use comes down, thus increasing overall demand and use. However,

[59] Ibid, loc 1772.

[60] Ibid, loc 2517.

[61] Ibid, loc 2531.

[62] Ibid, loc 2553.

despite these conclusions from Jevons, Foster et al. find his analysis wanting in its application. According to *Ecological Rift*, "[Jevons's] economic analysis took the form of static equilibrium…[and] was thus ill equipped to deal concretely with issues of accumulation and economic growth."[63] Foster et al. then take the opportunity to expand Jevons's analysis into a more holistic approach to the problem of excess atmospheric carbon accumulation. They include the example of the United States in which energy efficiency has doubled since 1975 while "its energy consumption has risen dramatically."[64] *Ecological Rift* then points to the work of economics Mario Giampietro and Kozo Uno, who found that efficiency increases result in an "increase scale and tempo of the system as a whole."[65] In effect, increases in energy efficiency may work to lower consumption in something like a steady-state economy. However under the auspices of the capitalist mode of production, greater efficiency drives increased demand and production. While *Ecological Rift* uses its discussion of the Jevons Paradox to combat ideas of technological improvement stopping or even slowing ecological degradation, it also reveals the inner machinations of the capitalist mode of production. The logical conclusion of their efforts means that an altered relation between capitalism and nature proves insufficient for fixing the metabolic relationship between man and nature.

2.4 The Treadmill of Accumulation

Foster et al. breakdown and revise the popular notion that renames capitalism as a treadmill of production. Using Paul M. Sweezy's *Monopoly Capital* as a foundation,

[63] Ibid, loc 2605.

[64] Ibid, loc 2677.

[65] Ibid.

Ecological Rift proposes an alternative reimagining of capitalism as a treadmill of *accumulation* partly in order to modify the treadmill of production's focus on scale by adding a focus on the system as well. The concept of the treadmill of production was first used by environmental sociologists Kenneth Gould and Allan Schnaiberg in their work *Environment and Society: The Enduring Conflict* and further elaborated in their next book *The Environment: From Surplus to Scarcity*.[66] Foster et al. admit to the usefulness of this concept insofar as it acts as a stand-in for naming capitalism. They explain that, while the concept was popular with organizations like the Environmental Protection Agency, the treadmill of production "in itself did not add anything indispensable analytically—not to be found in the more general Marxian (or neo-Marxian) ecological critique of capitalism."[67] This raises the question of what is meant by the treadmill of production and what their concept of the treadmill of accumulation accomplishes that the prior does not.

The treadmill of production in its earliest forms did specifically name monopoly capitalism and elucidate its connections to the treadmill of production, even referencing Paul M. Sweezy's *Monopoly Capital*. However, Sweezy along with thinkers like him "vanished completely from this second book…The historical specificity of the argument, which had been rooted in the analysis of the monopoly stage of production, was gone as well."[68] Regardless of its evolution, the treadmill of production attempts to situate the interactions between modern society and nature like *Ecological Rift*. The introduction to Schnaiberg and Gould's *Treadmill of Production: Injustice and Unsustainability in the Global Economy* explains the main thrust of the theory:

[66] Ibid, loc 2867.

[67] Ibid, loc 2896.

[68] Ibid, loc 2991.

> "Schnaiberg introduced the treadmill of production theory to address why U.S. environmental degradation had increased so rapidly after World War II. He argued that a growing level of capital available for investments and its changing investment allocation together produced a substantial increase in demand for natural resources. [The] major change outlined in the theory was that more capital was accumulating in Western economics and it was as being applied to replacing production labor with new technologies to increase profits. These new technologies required far more energy and/or chemicals to replace earlier, more labor-intensive processes, thus producing deeper levels of ecological disorganization the ever before."[69]

The treadmill of production refers to the situation in which the owners and operators of capital are incentivized to increase the scale and throughput of their operations to maximize profits despite the irrationality of such actions in the face of mounting environmental degradation.

Foster et al. find the treadmill of production analogy useful in its earliest conception wherein the focus was not only on the intensifying scale of production but on the system and relations which underpinned the explosive growth in production scale after 1945. Their revised notion of the *treadmill of accumulation* intensifies that focus on systematic relations. Here, they return to Marx, focusing on a definition of capital as "self-expanding value."[70] Using Marx's general formula for capital, where money is converted into a commodity through production and then sold for an increased amount of money, Foster et al focus on accumulation as a "dynamic [sic] enforced by the competitive tendencies of the system and

[69] Kenneth A. Gould, David N. Pellow, Allan Schnaiberg, *The Treadmill of Production* (London and New York: Routledge, 2016), 19.

[70] Foster et al., *The Ecological Rift,* loc 3017.

its at on with concentration and centralization of production."[71] The problem for the environment is not the rising scale of industry per se but the relations of production which incentivize monopolization and massive investments in hopes of maintaining a treadmill of accumulation of surplus value i.e., profit. From *Ecological Rift's* point of view, focusing on systematic relations as opposed to scale allows for a better understanding of the dialectical interplay between society and nature. They write that "[it] is not simply a question of scale but of dislocations or rifts in the environment…with the environment, capital seeks, for example, to replace an old-growth forest…with a simplified industrial tree plantain that is ecologically sterile, dominated by a single species, and 'harvested' at accelerated rates."[72] They find that a focus on scale and technological intensification ignores "the dialectical complexity and historicity of nature…"[73]. A focus on accumulation, then, includes the relations that a focus on production ignores.

Foster et al. include a quote from Paul M. Sweezy's article "Capitalism and the Environment" which underscores their perspective—

> "In their single-minded pursuit of profit…capitalists are driven to accumulate ever more capital, and this becomes both their subjective goal and the motor force of the entire economic system…[and] a system driven by capital accumulation is one that never stands still…[as] far as the natural environment is concerned, capitalism perceives it…as a means to the paramount ends of profit-making and still more capital accumulation. "[74]

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[71] Ibid.

[72] Ibid, loc 3047.

[73] Ibid.

[74] Paul A. Baran, Paul M. Sweezy, *Monopoly Capital* (New York: Monthly Review Press, 1966), 7-8

For the authors of *Ecological Rift* and Paul M. Sweezy, the problem is not one of intensification and massive scale as these are but the logical outgrowths of a system productive relations premised on relentless, unceasing capital accumulation. However, both *Ecological Rift* and *The Treadmill of Production* rightly judge that the crux of the issue is not to be found in consumption. There is little choice in a society of wage-workers but to consume in the economic sense. Both agree that "wants are manufactured in a manner that creates an insatiable hunger for more."[75] Regulatory regimes captured by big business along with entire credit-debt complexes, the massive, penetrating advertising industry, and the military-industrial complex waiting to soak up capital all work to ensure and contrive consumption. The problem is not one of consumption in the sense that neither the origins of nor the remedy to these treadmills can be found in consumer behavior.

2.5 The Realist-Constructivist Approach

In their chapter titled "The Sociology of Ecology," Foster et al. define their analytical approach by threading the needle between realists and constructionists. According to them, realists in environmental sociology tend to be materialists that "think in terms of nature's ontological independence of human action and conceptions."[76] In their opinion, overly realist conceptions of nature can suffer by discounting the "real" effects of human action in nature. Natural limits come about through interactions between society and nature, and are not independent—they are, in a sense, co-constructed. On the other hand, they find that constructionists, like those found under the umbrella of reflexive modernization theories,

[75] Foster et al., *The Ecological Rift,* loc 2879

[76] Ibid, loc 4358.

"tend to idealism and skepticism, and they stress the epistemological limits of our knowledge of nature."[77] Constructionists are more prone to suffering from double transference—i.e., the phenomenon wherein social relations are used to describe nature, and then these transposed "natural" relations are used to justify said social relations. Foster et al. bring up Marx and Engels' discussion of Darwinian evolution as an example of this double transference. Foster writes that: "Yet [Marx and Engels] were acutely aware that Darwin, as he readily admitted, had drawn some of his inspiration for the bourgeois political economy of Smith and Malthus…".[78] The problem here is that nature, interpreted under this regime, reifies and objectifies certain historical social relations as "eternal natural laws"[79] which then serve to further validate existing social relations. While the theory of evolution is not up for dispute, society's focus is on competition and "survival of the fittest" as opposed to the more operative tendencies of randomness, contingency, and extremely high rates of extinction. Foster et al. similarly reject the constructivist notions that presume the earth to have been in a natural, enduring harmony before the advent of industrial capitalism. Their focus is on the dialectical dynamism between nature and society that produces crises.

The cohort behind *Ecological Rift* fall somewhere closer to realist in their conception of nature, however, one which stresses dialectical interactions between nature and society wherein human action has an appreciable effect on the biosphere's processes and reproductive capabilities. Through an analysis of the history of ecology as an academic practice, Foster et al. trace the rise of constructivist and realist approaches in ecology, hoping

[77] Ibid.

[78] Ibid, loc 4701.

[79] Ibid, loc 4715.

"to illustrate, though a situated case, that the real concern of a sociology of modern ecology should *not* be the strict opposition of realism versus constructionism but rather the proper demarcation of each in the analysis of the coevolution of nature and society."[80] Their synthesis results in what they call the realist-constructivist approach to the sociology of ecology. The realist-constructivist approach "evolves out of this broad critically informed realist tradition and is an attempt to understand the social construction of ecological science—within the context of a philosophy of praxis emphasizing human attempts to transform (not merely mentally construct) the world."[81] A metabolic analysis is inherently constructionist as analogizing human work through nature to biological processes involves some level of non-realist abstraction. However, their focus on the dialectical interplay and the "coevolutionary and often crisis-laden relations between nature and society"[82] is grounded in a heavily materialist, realist approach.

2.6 Moore's Concern

Moore finds fault in concepts like metabolic rift because of their dualist construction. He criticizes theories like Foster's for, as he sees it, pitting society and nature against one another while failing to adequately analyze them as interconnected flows. The title of Foster and company's work, *Ecological Rift: Capitalism's War on The Earth,* presents a clear example of what Moore would consider a counterproductive framing. He instead advocates for a viewpoint that emphasizes the totality of nature as society and society as nature in a

[80] Ibid loc 4423.

[81] Ibid, loc 4530.

[82] lIbid, loc 4779.

"'Double Internality.'"[83] Moore claims that with an analysis rooted in such a "double internality" one can begin asking the right questions to productively analyze humanity and nature. For Moore, traditional green social analysis frames earth's deteriorating ecological as a question of" …[how] do humans disrupt nature, causing environmental degradation"[84] which only works to emphasize the binary of nature and man. Instead, Moore's analysis focuses on the questions: "First, how is humanity *unified* with the rest of nature within the web of life. Second, how is human history *co-produced* history through which humans have put nature to work…in accumulating wealth and power?"[85] This analysis feeds into a more significant point of Moore's which sees the ecological crisis primarily as a crisis of capitalism. This is due in part to his assertion that, "[c]apitalism is not an economic system; it is not a social system; it is a *way of organizing nature*."[86] From Moore's analytical vantage point, understanding the relation between man and nature means examining just that, the *relations*, as opposed to exploring these concepts as binary. Moore wants to go beyond environmental analyses that use environmental consequences as their focal point.[87]

Moore's analysis rests on a theoretical framing that examines "humanity-in-nature/nature-in-humanity"[88] to emphasize the totality of man and nature as interdependent relations in the web of capitalist social relations. This perspective precludes the notion of any

[83] Jason W. Moore, *Capitalism in The Web of Life: Ecology and the Accumulation of Capital* (London and New York: Verso Books, 2015), digital epub, 27.

[84] Ibid, 53.

[85] Ibid.

[86] Ibid, 31.

[87] Ibid, 63.

[88] Ibid, 65.

metabolic rift between man and nature as they can only be seen as one totality. He writes:"Rather than presume humanity's separation, in the recent or distant past, the *oikeios* presumes that humanity has always been unified with the rest of nature in a flow of flows."[89] Moore explains his use of the Greek *oikeios* as "a way of naming the creative, historical, and dialectical relation between, and also always within, human and extra-human natures."[90] Using this concept, Moore privileges how history develops through nature as opposed to interacting with nature. This reasoning means that, instead of ecological consequences occurring due to social interactions with nature in a cause and effect style, one should "emphasize the environmental history *of* social relations,"[91] in a more holistic, flowing framework.

Moore gives considerable attention to the premises espoused in *Ecological Rift*. In his introduction to *Capitalism in The Web of Life*, he writes that "the issue is not 'metabolic rift' but *metabolic shift*"[92] and devotes an entire chapter to this reinterpretation. He sees a problem in Foster et al.'s extension of Marx's metabolic rift to the domain of overall ecological processes. Moore claims that metabolic analyses like those found in *Ecological Rift* fall into the unproductive trap of a dualist conception of man and nature. He writes, "Metabolism-centered studies face an unresolved contradiction: between a philosophical-discursive embrace of a relational ontology (humanity-*in*-nature) and a practical-analytical acceptance

[89] Ibid, 67.

[90] Ibid, 156.

[91] Ibid, 172.

[92] Ibid, 77.

of the Nature/Society dualism (humanity *and* nature)."[93] For Moore, the unresolved contradiction in works like *Ecological Rift* stem from their ostensibly correct theoretical framing but faulty analytical reasoning. They proceed from a holistic, relational perspective into one that over-emphasizes a duality between man and nature.

Moore concedes that the concept of metabolic rift makes certain sense and is an overall attractive way of describing the relations between man and nature. However, in Moore's conception, theories like Foster's ecological rift sacrifice necessary subtleties in favor of that theoretical clarity.[94] He writes, "At the core of this epistemic rift is a series of violent abstractions implicated in the creation and reproduction of two separate epistemic domains: 'Nature' and 'Society.' The abstractions are "violent" because they remove essential relations from each node in the interests of narrative or theoretical coherence."[95] Despite being clear in its analysis, Moore's problem with *Ecological Rift* arises from its lack of totality in favor of dualism; social systems should not be over-conceptualized as distinct from and acting upon nature. Moore's method of seeing the human-nature dialectic as *oikeios* or a totality focuses on "humanity's place *within* the web of life."[96] Despite "rift" being an admittedly useful heuristic, Moore finds that an idea of metabolic *shifts* instead of rifts more accurately describes the situation, and in his words, "opens the possibility for thinking through a singular metabolism of power, nature, and capital."[97] This style of analysis leads to, in this

[93] Ibid, 312.

[94] Ibid, 314.

[95] Ibid.

[96] Ibid, 173.

[97] Ibid, 174.

article's opinion, similar conclusions as *Ecological Rift,* however, focusing on different key mechanism like energy/value, frontiers, and Moore's concept of cheap nature.

2.7 Cheap Nature

Moore's analysis proves itself most useful when reconsidering Marx's Theory of Value and its corollary—the tendency for the rate of profit to fall—as they relate to capitalism's dynamic flexibility and its place as a world-ecological process. Moore clarifies that he conceptualizes capitalism not primarily as a system of social re/production but as a way of organizing nature.[98] Similar to *Ecological Rift*, Moore finds importance in relations of industrial capitalism and nature: "…the basic argument remains as sound as ever: modernity's epoch-making reorganizations of labor and land were premised on the ruthless conquest and the *ongoing appropriation* of wealth on the frontier."[99] Moore's use of the word "appropriation" in the prior quote is idiosyncratic and an integral part of his retooling of Marx's theories. Central to Moore's intention of incorporating value relations into ecological analysis are the intertwined processes of appropriation and capitalization. Moore explains, "The reduction of socially necessary labor-time through commodification is what I have been calling capitalization; the maximization of unpaid work in service to capitalization, is what I have called appropriation."[100] In other words, capitalized inputs are those that involve direct, fair (under prevailing conditions) compensation, such as wage-work or machinery

[98] Ibid, 173.

[99] Ibid, 187.

[100] Ibid, 689.

investments, while appropriated inputs are those inputs that are necessary for the reproduction of the system but go most unaccounted and unpaid for.

In Moore's framework, nature's "work" (especially that of raw materials, accumulated nutrients in the soil, and energy sources like oil) has not only been appropriated, but its appropriation is vital for the capitalist system at large.[101] Moore considers cheap energy one of the Four Cheaps along with labor, food, and raw materials which all in turn make up Cheap Nature. He writes, "Capital must not only ceaselessly accumulate and revolutionize commodity production; it must ceaselessly search for, and find ways to produce, Cheap Natures: a rising stream of low-cost food, labor-power, energy, and raw materials to factory gates…"[102]. Cheap Natures exist as frontiers of appropriation which "are bundles of uncapitalized work/energy that can be mobilized, with minimal capital outlays, in service to rising labor productivity…"[103]. Certain historically specific formations of capitalism reach a point of crisis when the rate of appropriation of unpaid work cannot keep up with the increasing rate of the capitalization of said work. For Moore, this inherent contradiction in the logic of capitalism (as a project dependent on appropriating Cheap Nature) engineers the conditions under which capital relations must expand and reorganize around new frontiers of appropriation to avoid or end crises. He summarizes the thrust of his analysis as such: "This is a story of how the historical nature that is created at the outset of an accumulation cycle-(re)launching the Four Cheaps with a high rate an mass appropriation of unpaid work/energy—experiences contradictions that must be resolved through new world-

[101] Ibid.

[102] Ibid, 132.

[103] Ibid, 335.

ecological revolutions."[104] Capitalism's dynamism comes from its need to reconfigure itself in search of Cheap Nature to appropriate as rising capitalization increases costs and interrupts the accumulation process.

Moore uses several examples of this phenomenon playing out from across what he calls the long sixteenth century (1451-1648) to the twenty-first century highlighting how capitalism operates in historically distinct formations. It's important to note that Moore does not consider these economic dynamics to be non-contingent in the sense that they operate outside the sphere of socio-historical factors, including technical knowledge, prevailing cultural attitudes, organizational capabilities, and especially labor relations. Instead, he focuses on how these forces, especially as they act as rationalizing agents, act within the totality of capitalism as an ecological project. He writes, "If appropriation is partly about primitive accumulation, it is equally about the cultural hegemonies and scientific-technical repertoires that allow for unpaid work/energy to be mobilized…for capital accumulation."[105] Moore's examples of these forces at play focus on how they affect the reconfigurations of capital relations unfolding over the medium to long-run especially in regards to appropriation and capitalization.

2.8 Mining and Farming

Moore investigates the migration of European mining centers from Central Europe in the fifteenth century to Spain by the seventeenth. He writes that "…the origins of capitalism

[104] Ibid, 275.

[105] Ibid, 223.

are partly to be found in Central Europe's mining boom after 1450."[106] He goes on to explain that due to technological and organizational innovations Central Europe was able to quintuple their output of silver, copper, lead, and iron.[107] However, by the 1550s, prime mining production had moved elsewhere, and Central Europe was no longer atop the industry.[108] Using his concept of the "double-internality" of society and nature, Moore investigates the cause behind this geographical movement of resource extraction, finding it more than just a matter of resource exhaustion. He writes that production "declined because Central Europe's extractive complex was increasingly exhausted in is capacity to advance (or even sustain) labor productivity."[109] He points to a variety of factors behind this failure to advance labor productivity (rate of exploitation) including: ore quality, labor unrest, geographical challenges for construction, and the rising prices of timber.[110] Under his paradigm of the Four Cheaps, one finds that the production complex in Central Europe faced a rising capitalization of appropriated extra-human and human natures. The rising cost of inputs like timber and the likely need for increased investment to face geographical challenges indicates a need to appropriate labor in hopes of maintaining profitability. However, there was labor unrest and rising wages[111] meaning there was little more appropriation to be found. The rate

[106] Ibid, 136.

[107] Ibid.

[108] Ibid.

[109] Ibid.

[110] Ibid.

[111] Ibid.

of capitalization had overtaken the rate of appropriation and the relations of production which underpinned the mining industry reached a crisis point.

Moore uses an example in which a production crisis resolves through the discovery of new appropriations. After moving from Central Europe, silver mining took off with "…Spain's enclosure of the Cerro Rico ('Rich Mountain')…ores were rich, fuel plentiful, and labor cheap. Within two decades, however, production collapsed."[112] He points out similar conditions to those that stifled Central European production such as declining ore quality, rising smelting costs, and uncooperative labor.[113] As before, he uses his "double-internality" perspective to understand these forces as co-produced between society and nature with exhaustion occurring not in the resource itself but in the relations which allowed for resource extraction. Unlike in Central Europe however new appropriations were found to stave off extended crisis. Moore summarizes:

> "This ushered in one of early capitalism's most spectacular episodes of socio-ecological transformation. The arrival of a new Viceroy…in 1571 was followed by a far-ranging transformation. A new method of extracting silver…was instituted. A radical process of agrarian restructuring…was launched to ensure a steady supply of cheap labor power for the mines. Vast hydraulic infrastructures were built to power the mills…[and] labor organization moved from arms-length sharecropping to more direct forms of labor control."[114]

In this example, Spain was able to revive its faltering mining industry by, in Moore's view, extending and intensifying appropriations. Increased control over labor along with

[112] Ibid, 137.

[113] Ibid.

[114] Ibid.

technological advances helped increase labor productivity and thus the rate of appropriation without a commensurate rise in the rate of capitalization. This example also points to the importance of geographical, sociological, cultural and historical factors and their role in accommodating or limiting the rate of appropriation.

Moore devotes the entirety of the last chapter of *Capitalism in the Web of Life* to investigating the centrality of Cheap Food in capitalist appropriation, especially as it relates to industrial agriculture. Moore's discussion includes examples of waning agricultural productivity in eighteenth century England, and its corollary, the booming growth of industrial agriculture in nineteenth-century United States. These examples reveal how the contradictions that led to an agricultural crisis in England were resolved through a restoration of the four cheaps in the United States. Additionally, this juxtaposition provides a fruitful look at the roles of globalization and geographical expansion in accelerating appropriations. Like Marx and Foster before him, Moore's analysis of modern agriculture emphasizes soil fertility and exhaustion. And, similar to his argumentation in the prior examples of mining, Moore complicates the idea of resource exhaustion by again pointing to the exhaustion of the relations of production as the real culprit—a conclusion this article finds in line with both Foster and Marx's thinking.

By the mid-eighteenth century, England's agricultural productivity had stagnated[115] despite its abundance of Cheap Energy, appropriated in Moore's perspective, in the form of coal. He writes that "Cheap Energy allowed for the simultaneous decline of input costs and the advance of labor productivity is no small thing…"[116]. This feat was accomplished not

[115] Ibid, 607.

[116] Ibid, 302.

only by the fact that coal was readily available with limited capital investment, but through the technological breakthrough of smelting iron using the coal-derivative coke.[117] These allow for an extended appropriation of commodity frontiers while increasing the rate of exploitation. However, these could not reproduce the relations of capitalist production on their own—labor relations and food prices checked these rising appropriations. Rising urbanization brought on by enclosure acts and the proletarianization of peasant farmers increased the demand for food to the point where agricultural productivity could not keep up.[118] Moore found that "…English food prices increased twice as fast as the industrial price index at the end of the eighteenth century. Relative to textiles and coal, food prices increased by 66 percent and 48 percent, respectively between 1770 and 1795."[119] The year 1760 marks a turning point for Moore in which Parliamentary Enclosures increased sixfold in terms of acreage.[120] He writes: "Long inflationary swings have been…moments through which the bourgeoisie deploys the power of the market—backed by the power of the state…—to redistribute value from the producers to the accumulators of surplus value."[121] He continues with this line of reasoning concluding that proletarianization along with inflation could have two results: rising wages for workers or "forced underconsumption."[122] He finds the latter to

[117] Ibid.

[118] Ibid.

[119] Ibid, 297.

[120] Ibid, 298.

[121] Ibid, 299.

[122] Ibid, 300.

be what happened, however he indicates that under-consumption as a strategy can only go so far, and new appropriations must be harnessed.

In the case of England, Moore does not find a natural limit to soil productivity as the precipitating factor negatively affecting agricultural productivity. Indeed, the practices for maintaining soil fertility and yields were known but just not doable under the prevailing conditions of capital relations. Moore quotes the historian Kenneth Pomeranz to illuminate the situation: "'…much of what they learned about how best to maintain soil fertility while increasing yields was not actually applied in England, because it involve highly labour-intensive methods and English capitalist farmers…were intent on labour-cost minimization and profit maximization.'"[123] Thus soil fertility did not present a hard limit to increasing agricultural productivity as such. Instead, Moore finds this "biophysical impasse was itself a co-produced limit of capitalist relations."[124] The solution to declining agricultural productivity,—i.e. reinvigorating the increasingly exhausted soil with key nutrients—would provoke an untenable rise in labor costs. Despite the leaps in technology that would occur during England's industrial revolution the issues of securing Cheap Food remained. The problem of restoring cheap food as an input was only resolved through an extension and intensification of the zones of appropriation in America.[125]

The transition of what Moore calls the "breadbasket of capitalism" from Europe to the America in the nineteenth century hinged on the nascent United States government's ability to make "the continent legible for capital accumulation."[126] While the United States of the

[123] Ibid, 558.

[124] Ibid, 268.

[125] Ibid.

[126] Ibid, 271.

nineteenth century was ripe with untapped appropriations and instances of Moore's Cheap Nature, the relations of production necessary to accumulate a surplus through both appropriation and capitalization necessitated a strong central government. Moore writes, "For the creation of a strong centralized state was fundamental to the creation of a regime of abstract social nature…that ensured the expanded reproduction of bourgeois property across the continent." [127] Abstract social nature here refers to the reified, rationalized, and quantifiable aspects of nature necessary for appropriation and capitalization. Vasts rates of appropriation were to be found in a continent newly and, in many cases, violently tamed by the forces of capital resulting in the birth of American industrial agriculture.

Moore highlights how Cheap Nature was integral to American becoming Europe's breadbasket: "…the Midwestern and Great Plains frontiers offered up millennia of accumulate nutrients (and water), which sustained industrial agriculture's rapid advance…Western Kansas wheat farmers in the 1870s enjoyed labor productivity that outstripped some European cultivators by an order of magnitude."[128] Between 1840 and 1900, Moore notes that,"[labor]-time in maize cultivation fell by nearly two-thirds in pre-harvest work, and one-half in harvesting"[129] This was done without increasing the land productivity for maize (or wheat for that matter).[130]The intensification of labor productivity brought on through mechanization relied heavily on large returns from appropriating Cheap Nature. The rise of American industrial agriculture and labor productivity, on the back of

[127] Ibid, 269.

[128] Ibid, 271.

[129] Ibid, 270.

[130] Ibid.

Cheap Nature, allowed for the restoration of Cheap Food in Europe. As Moore succinctly puts it:

> "The emergence of new major centers of production—with their distinctive patterns of industrial organization and rising labor productivity—is premised on the mergence of more expansive nets of appropriating the unpaid work/energy of human and extra-human natures. These configurations of capitalization (within the circuit of capital) and appropriation (outside that circuit but within reach of capitalist power) allow for long waves of accumulation to unfold."[131]

The United States would then go on to face the same contradictions that occurred in England. By not investing in soil fertility along with the heavy agro-industrialization, the "'soil mining' strategy…became increasingly counterproductive as the frontier closed."[132] Frontiers begin closing when the rate of capitalization outstrips the rate of appropriation.

The relations of capital in the United States found renewed vigor in the 1930s through intensive consolidation of farms and the advent of "petro-farming"[133] which allowed for massive inputs of non-local Cheap Energy in the form of oil and gas along with the introduction of pesticides and herbicides.[134] Cheap Energy underpinned increasing rates of industrialization and capitalization while, under Moore's framework, maintaining even higher levels of appropriation. Cheap Energy in the form of oil and gas had a tremendous upside for maintaining increasing rates of appropriation. Coal could not power England through its Cheap Food crisis, but oil and gas extended the frontiers of appropriation more effectively in

[131] Ibid, 276.

[132] Ibid, 565.

[133] Ibid, 262.

[134] Ibid, 232.

the United States. Moore continuously highlights the key contradiction at play. Accumulation necessitates both capitalization and appropriation, but the rate of appropriation diminishes over time as more capital outlay is needed to extract what was once Cheap Nature, thus new commodity frontiers ripe for appropriation are needed.

2.9 How Moore Draws on Marx

The previous sections of this article hint at how Moore has refocused Marxian concepts with ecology in mind, and while not groundbreaking, his analysis provides a useful framework and vocabulary for understanding capitalism as it operates with and through nature. Moore's perspective is appreciable non-reductionist as he understands the movements of capital relations to be contingent on labor relations and historical formations like that of the state. This section will make his connections to Marx more explicit by using Moore's world ecological surplus.

Moore defines the ecological surplus as "[t]he ratio of the system-wide mass of capital to the system-wide appropriation of unpaid work/energy."[135] This means that a high ecological surplus is correlated with economic expansion and high rates of accumulation. He writes that "[g]reat advances in labor productivity, expressing the rising material throughput of an average hour of work, have been possible through great expansions of the ecological surplus."[136] In Moore's examples from the prior section, crises occurred when the ecological surplus had fallen to an unsustainable point, and these crises could only be rectified through the appropriation of new frontiers for appropriation. He ties the concept of ecological surplus

[135] Ibid, 224.

[136] Ibid, 226.

with tendency for the rate of profit to fall resulting in a new maxim—the tendency for the world ecological surplus to fall as capitalization rises.

In traditional Marxian analysis, as owners invest more into constant capital like machinery while minimizing the cost of raw materials, labor productivity rises through capital intensification.[137] This increase leads to a rise in the organic composition of capital (defined as the ratio between constant capital to labor costs) which in Marx's conception leads to a falling surplus value and thus a falling rate of profit for the owners of capital. This tendency is just that, a tendency, and Moore shows how, through the appropriations of Cheap Nature, it can be checked. In the example of the early twentieth-century agricultural industry in America, rising labor productivity and technology investment was kept profitable through greater appropriations of Cheap Energy in the form of oil and gas. He writes, "The ecological surplus declines over the course of every long wave of accumulation…"[138] which in part has to do with declining rates of appropriation in the face of rising capitalizations which in turn produce a declining rate of profit.

Moore highlights several mechanisms by the ecological surplus under specific formations of capital-relations fall. First, as touched on before, there lies an inherent contradiction with the capitalist mode of production wherein the process of appropriation becomes a snake eating its own tail. In other words, accumulations necessitate some degree of capitalization. However, as more nature becomes capitalized, both further capitalization and appropriation become untenable. He writes: "At first liberating new flows of unpaid work/energy, capitalization progressively limits those flows."[139] In the case of agriculture,

[137] Ibid, 159.

[138] Ibid, 109.

[139] Ibid 129.

Moore looks at the reorganization of land to make it legible for capital accumulation and agro-industrialization as sowing the seeds of its own slowdown. He continues: "Thus the tendency of surplus capital to rise, and of ecological surplus to fall, constitute an irreconcilable contradiction between the project of capital and the work of the natures that make that project possible."[140] He points to the rising proletarianization of peasant farmers and the transition from old-growth forests to tree plantations as indicative examples of how capitalization rises over time.

Another key reason the ecological surplus falls according to Moore has to do with the temporal inconsistencies between the reproduction of time capital and the reproduction time of natural inputs.[141] He explains that "[costs] rise because appropriation imposes a peculiar temporal logic on nature. This temporal discipline undermines daily and inter-generational reproductive conditions by enforcing the systemic disciplines of 'socially necessary turn-over time.'"[142] One sees this in the examples of soil exhaustion used by all three of Moore, Foster, and Marx. The temporal logic of capital demands ever-increasing labor productivity and high turnover which involves more capitalization as nature's reproduction rate cannot keep up. The easily appropriated spoils of nature cannot be reproduced under the temporal regime that animates capitalism's dynamism. According to Moore, agricultural revolutions such as the one in nineteenth century America have been absolutely key in restoring an ecological surplus. Temporality connects to Moore's discussion of waste frontier and negative value. Here, the connection to plastic proliferation becomes most apparent.

[140] Ibid.

[141] Ibid, 110.

[142] Ibid, 163.

2.10 Waste Frontiers and Negative Value

Moore uses the concepts of "taps" and "sinks" to understand the growth of negative value. He defines negative value "as the accumulation of limits to capital in the web of life that are direct barriers to the restoration of the Four Cheaps: food, labor-power, energy, and raw materials."[143] Negative value represents an inhibitory feedback mechanism within capital relations. An important aspect of negative value is how it captures "the ongoing, and impending, non-linear shifts of biosphere and its biological systems…"[144]. Here, the incongruent temporalities and asymmetric relations between and among nature and society become apparent.

According to Moore, under the logic of capitalism, abstracted social nature is operationalized as either a tap (for resource extraction) or a sink (for waste accumulation). The problem arises within this duality. Moore writes that "…the temporality of nature-as-tap differs significantly from the temporality of nature-as-sink."[145] The costs associated with using nature as a sink have had to be continuously outrun by opening more waste frontiers. Moore continues:

> "New primary production regimes, until now, could develop faster than did waste-induced costs. Out running these contradictions was possible because there were geographical frontiers—not just continents, but bodily, subterranean, and atmosphere

[143] Ibid, 294.

[144] Ibid, 295.

[145] Ibid, 296.

> spaces—from which "free gifts" could be extracted, and into which "free garbage" could be deposited…It also produces a *general law of overpolllution:* the tendency to enclose and fill up waste frontiers faster than it can locate new ones."[146]

Climate change and global warming are to Moore direct results of the closing waste frontier and indicate the severity of accumulated costs. The atmosphere can no longer act as a sink for carbon dioxide without incurring high costs to capital in the form of climate change. Negative value, as an inherent byproduct to the capitalist mode of production, presents a contradiction in the flow of capital. While large energy inputs from oil and gas, along with the chemical inputs of fertilizers and pesticides (and plastics!) have powered capital to expand and intensity its zones of appropriation, the accumulation of negative value has left capitalism with a deep, possibly intractable, crisis. Logically, the accumulation of negative value spurs more capitalization in the increasingly vain search for new frontiers of appropriation as the ecological surplus continues its fall. Moore ends his book with this relevant sentiment: "The end of cheap garbage may loom larger than the end of cheap resources."[147]

2.11 Potential for Synthesis

Ecological Rift and *Capitalism in the Web of Life* take very different routes to examine the same idea—the connections between capitalism and nature and how crises (environmental in the case of Foster and economic in the case of Moore) occur. Moore takes a highly expansive historical approach finding the origins of capitalism in the long sixteenth century, and tracking its reconfigurations over multiple centuries. Foster, on the other hand, focuses especially on the modern phase of industrial capitalism when fossil fuels became

[146] Ibid, 297.

[147] Ibid, 335.

integral to the world system of production. Moore's analysis, while full of analytically useful tools and reconsiderations, sacrifices clarity for complexity leaving his arguments scattered across the book. The metabolic rift analysis proposed by Foster et al. provides a more accessible scaffold and framework for executing an analysis of the proliferation of plastic. Despite the reductive tendencies in the metabolic rift analysis, one can proceed with it while keeping in mind Moore's insistence that society-in-nature and nature-in-society are co-produced as opposed to dualistic antagonists. Additionally, Moore's deep economic analysis will prove useful as his concepts of Cheap Nature, ecological surplus, and negative value support a metabolic rift analysis especially in regards to plastic. One can thread the theoretical needle by taking *Ecological Rift's* premises of a rift in the social metabolic order of capitalism and nature while keeping in mind Moore's insistence that these not be treated dualistically. The flow in flow analysis of Moores' humanity-in-nature/nature-in-humanity does not have to be diametrically opposed to scrutinizing the specific dialectical nature inherent to such a construction. Furthermore, Moore's concept of cheap nature and the unaccounted for 'work' of nature can find a place in Foster's analysis of the alienation of man from nature. In its conclusions, this article will attempt to synthesize Foster's idea of metabolic rift and Moore's notions of cheap nature to analyze the proliferation of plastic in the environment.

Part 3: American Plastic in the Land of Desire

Jeffrey Meikle's text *American Plastic: A Cultural History* offers a thorough survey of the origins and growth of plastic production in the United States. This article will focus especially on the production and advertising surrounding Bakelite—the first synthetic

plastic.[148] From its inception in 1907, Bakelite grew into its tagline—the material of a thousand uses[149] —bestowed upon it in the 1910s as the advertising industry tried to gain a foothold in the pubic's imagination. The eventual fate of the Bakelite corporation tracks another key development in this era. Leo Baekeland created Bakelite and went on to be the CEO of the Bakelite Corporation. These times focused on individual ingenuity and creative "genius"were supplanted by the consolidation and monopolization of businesses across markets. Bakelite was eventually sold to Union Carbide in 1939.[150] Consolidated corporations had the capital necessary for the kind of research and development that led to the Dupont Corporation's synthesis of nylon in 1934. The production and public reception of Nylon stockings point to a growing realism in understanding plastic's usefulness. These corporations would also prove pivotal in the transition from producing durable thermoset plastics to thermoplastic's like polyethylene which proved itself perfect for mass production.

Meikle's work necessitates historical context especially as it relates to the rise of a consumer culture in which plastic would become a vital component. Without a mass consumer culture, the vast majority of thermoplastic production would make little sense. Historian William Leach's *Land of Desire: Merchants, Power, and the Rise of a New American Culture* investigates the origins of merchandising and mass consumer culture in early twentieth century United States. His text shows that a growing divorce between the means of consumption and production for large swathes of the population had been well underway by the time synthetic plastics hit the market in the 1910s, and how this divorce was necessary in the emergence of mass consumer culture. Farms had been consolidating and the

[148] Jeffrey Meikle, *American Plastic: A Cultural History,* loc 109.

[149] Ibid.

[150] Ibid, loc 1487.

population, divorced from their means of production, was being converted into wage-workers. *Land of Desire* shows how intensive merchandising and consolidation aligned with pro-business government policy and new urban geographies colonized by advertising in the form of billboards, neon signs, and window displays all worked to create a consumer culture—the culture into which plastic was born.

3.1 Consumption and Production

Land of Desire tracks the emergence of mass consumer culture in the United States identifying key historical processes from 1890 to 1930 that proved pivotal in crystallizing the new consumer-oriented culture. Leach emphasizes the growing separation between people's means of production and their means of consumption during the period, an important predicating factor for the rise of consumer culture. He summarizes:

> "This was unprecedented. Before 1880, consumption and production were, for large numbers of people, bound together, with men, women, and children living and toiling closely with one another…in local or regional economies, and sometimes self-sufficiently. Most Americans knew where the goods and wealth came from, because they themselves produced them, knew their value, and understood the costs and sufferings required to bring them into existence."[151]

The growth of capital investments and increases in labor productivity along with consolidation in agriculture (a key factor in Jason W. Moore's analysis of Cheap Food) meant that "more Americans, no longer owning land or tools, were compelled to rely on money incomes—on wages and salaries—for their security and their well being…"[152]. The growing

[151] William Leach, *Land of Desire: Merchants, Power, and the Rise of a New American Culture* (New York: Vintage Books, 1993), digital epub, 256.

[152] Ibid, 28.

capitalization of American production meant an increase in what would be called 'consumers' today. However, a separation between consumption and production does not inherently create the mass consumer culture that would take shape in the United States in the early twentieth century—it is only a prerequisite in this case. Leach makes reference to a growing "cult of the new" in early twentieth century America where one could remake themselves in a land of plenty with new traditions, acquisitions, and change.[153] This along with what he calls the "democratization of desire" defined as "…equal rights to desire the same goods and to enter the same world of comfort and luxury."[154] Pivotal in democratizing desire was the transition from local, open-air markets to the consolidated department stores of the 1900s.[155]

Department stores personified the growing trend towards centralization and merchandizing that paved the way for a mass consumer culture. Leach explains that "[more] than other business, departments stores revealed the totality of what the American economy was producing and importing. In the 1880s, most stores had only fifteen small departments, but by 1910, many offered upward to 125."[156] Department stores offered a vast array of commodities in one central place from pianos, toothbrushes, and groceries to exotic pets. Their success was to be found in the fact that "they sold a world of new goods under one roof, concentrated ownership and controlled large capital sums…crushed or absorbed their

[153] Ibid, 25.

[154] Ibid, 26.

[155] Ibid, 115.

[156] Ibid, 51.

competitors, and demonstrated great individual skill."[157] One could materially see and understand the wealth of the American economy—measured in the breadth and array of commodities up for consumption—by shopping in department stores. Leach focuses especially on the Philadelphian John Wanamaker and his retail business. Wanamaker's extraordinary and early success in retail and department stores culminated in a twenty-four story department store in 1912 Philadelphia,[158] and his overall expansions were instrumental in the democratization of desire. The economic relations underlying this burgeoning consumer culture, however were still of prime importance. Wanamaker and similar tycoons began to fear overproduction crises singling out the problem of distribution.

3.2 Manufacturing Desire

The potential problem for Wanamaker and his ilk (including the banks and commercial enterprises supporting their department stores) was that "it became clear that consumption—and distribution and marketing—could not be taken for granted."[159] Improving technical and productive capacity naturally led to fears of overproduction and eventual financial insolvency. While technical factors of distribution were considered, the real challenge was "producing a new consumer consciousness, by transforming the imagination."[160] A new and sophisticated advertising apparatus would be created to manufacture the desire for commodities in the American public through imagination and association. Leach explains

[157] Ibid, 47.

[158] Ibid, 70.

[159] Ibid, 73.

[160] Ibid, 75.

that "business pursued the imagination in a way no other gourd in U.S. history had ever done. It turned to new methods of marketing and the dissemination of strategies of enticement—advertising display and decoration, fashion, style, design and consumer service."[161] The rise of consumer culture in the early twentieth century coincided with the rise of cheap electric lights and glass, which would prove pivotal in inducing desire.

Advertising would help establish the symbols, images, and values appropriate to a mass consumer culture. Leach writes: "Cultures must generate some conception of paradise or some imaginative notion of what constitutes the good life. They must bring to life a set of images, symbols, and signs that strip up interest at the very least, and devotion and loyalty at the most."[162] With the advent of cheap lights and glass, these new symbols were disseminated through the power of the window display, light-up neon signs, and massive billboards. Leach bring up a variety of examples such as a Coca-Cola billboard so large it obstructed the view of Niagra Falls, while New York's Broadway sported a "forty-five-foot Heinz pickle in green bulbs…"[163]. The onslaught of images, now taken for granted, was greatly opposed by some at the time. Leach quotes sociologist Edward Ross who traveled through America in 1912 as saying, "In the city every accessible spot where the eye may wander, frantically proclaims the merits of somebody's pickles or Scotch Whiskey…[but] why should a man be allowed violently to seize and wrench my attention every time I step out of doors, to flash his wares into my brain with a sign?"[164] Advertisers of the time seemed unbothered by negative

[161] Ibid.

[162] Ibid, 30.

[163] Ibid, 91.

[164] Ibid, 93.

reactions as long as reactions were to be had. Leach includes a quote from the successful advertising man O.J. Gude which crystallizes the growing advertising movement: "Gude was delighted that these signs 'literally forced their announcements on the vision of the uninterested as well at the interested passerby…[sign] boards are so placed…that everybody must read them, absorb them, and absorb the advertiser's lesson willingly or unwillingly.'"[165] Inducing desire did not have to be pleasant so much as successful—and advertisers continued to develop more sophisticated and attractive methods of manufacturing desire in the public. However, advertising cannot be the end all be all. Leach shows how an entire social-complex arose to support mass-consumer culture and the manufacture of desire.

3.3 More than Advertising

Land of Desire shows how the university system, the federal government, and investment banks worked in concert to rationalize and improve the technical aspects of business that came with mass production. In the 1890s, the only university that focused on commercial business practices was the University of Pennsylvania's Wharton School of Economics.[166] Over the course of the early twentieth century, this would of course radically change with universities becoming much more attuned to the needs of business as consumer culture began to dominate the country. Leach single's out Harvard Business School and its first dean appointed in 1908—the economist Edwin Gay—as a model for how this growth happened. He writes that Gay instituted a new curriculum with subjects like "advertising,

[165] Ibid, 92.

[166] Ibid, 267.

investment finance, cost accounting, modern banking, merchandising, retailing, and economic price movements."[167] Clearly, a monumental shift in the priories of some universities was happening. In addition to revamping education for business, Gay instituted the Harvard Bureau of Business Research as "the first such institution to study marketing, merchandising, and…distribution."[168] Gay wanted to focus less on production and more on distribution and methods for maximizing the reach of the market.[169] This change would be the start of a wave in rationalization and quantification to help commercial enterprises better sell their products to consumers. Distribution would be a main focus as the Harvard Bureau of Business Research "investigated the retail grocery business in 1914, wholesale shoe firms in 1915, the wholesale grocery business in 1916, retail general stores in 1917, retail hardware dealers in 1918, and retail jewelers in 1919."[170] Merchants and bankers considered the data invaluable, especially as it related to finding consumers, decreasing costs, and opening their eyes to opportunities for consolidation through mergers and buy-outs. In the end, the focus was still on maintaining ever-intensifying demand for commodities—as Leach notes, "[marketing] and distribution soon surfaced as top subjects for the bureau's analysis."[171] Producers were concerned with getting goods distributed and sold quickly, cheaply, and continuously.

[167] Ibid, 278.

[168] Ibid.

[169] Ibid.

[170] Ibid, 282.

[171] Ibid.

The trend of knowledge production for businesses would culminate in President Herbert Hoover's (1929-1933) Commerce Department and its imperative to provide business with up-to-date information regarding metrics of production, distribution, and consumption.[172] It was under Hoover, Leach notes, that words like mass consumption became normalized and valuable. Hoover "did not take consumption for granted…he realized that consumption, like production, had to be created and managed in the new corporate economy."[173] President Hoover, usually touted as the raging laissez-faire capitalist that instigated the Great Depression, finds a new interpretation in *Land of Desire*. Leach considers him a "managerial statist"[174] who believed it was the government's mandate to ensure the markets operated properly. Hoover believed that a properly managed capitalist market could end scarcity and poverty and usher in an age of ever-increasing abundance. Markets just needed the proper knowledge structures to enhance their ability to make rational decisions. Leach writes, "Hoover changed the Commerce Department into a brokering agency to feed American businesses an ongoing flow of data so they might achieve 'better control of economic forces' and 'equilibrate' and 'rationalize' consumption and production."[175] Despite the ensuing Great Depression, Leach finds that Hoover established a business culture that weathered the storm of economic depression and continued to enhance and encourage a culture of mass consumption. Americans became consumers first and citizens second.[176]

[172] Ibid, 625.

[173] Ibid, 620.

[174] Ibid, 618.

[175] Ibid, 625.

[176] Ibid, 468.

3.4 Happiness-Machines

The American public had the tough task of incorporating consumerism into existing religious beliefs and cultural attitudes. The culture of mass consumption needed to take root, somehow, in an American's self conception and understanding of themselves within their own local, historical contexts. Advertisements inducing one to buy any number of unnecessary goods would be hard-pressed selling to the old Christian Protestant mindset of savings, austerity, and self-denial. Leach points to the popularity of new religious sects like theosophy, New Thought, and mind-cure as indicative of the development of a new American cultural framework focusing on happiness on earth through consumption as opposed to happiness after death through self-denial and austerity. Leach writes that "these faiths wanted to make religion work in the modern era, to integrate it with secular and scientific aspirations, and to accommodate it to ever-expanding material desires."[177] Adherents to theosophy and mind-cure were concerned with attaining a heaven-on-earth through consumption. Leach quotes several prominent spokespeople in these movements to underscore the rise of a new American self-conception that rejected guilt and embraced self-fulfillment. Orison Swett Marden, a proponent of New Thought and writer of inspirational books, commanded his audience to: "Wake up and stretch yourself…The only thing that keeps us from taking plenty of either money or air is fear."[178] With problems of scarcity receding into the background, it appeared that people in the United States had a world of plenty right at their fingertips if only they let themselves desire and attain it. Leach's second quote from Marden in 1903 is especially illuminating and is reproduced here in full:

[177] Ibid, 404.

[178] Ibid, 407.

> "If you want to get the most out of life, just make up your mind that you were made to be happy, that you are a happiness-machine, as well as a work-machine. Cut off the past, and do not touch the morrow until it comes, but extract every possibility from the present. Think positive, creative, happy thoughts, and your harvest of good things will abundant."[179]

Another key figure Leach identifies in the theosophy movement is L. Frank Baum the author of *The Wizard of Oz*(1900). While Leach devotes ample space for analyzing *The Wizard of Oz*'s impact consumerist culture, this article just briefly touch on it. In creating a uniquely American fairy-tale for children, Baum :

> "broke the connection between wonderment and heartache. People could have what historically (and humanly) they had never had: joy without sorrow, abundance without poverty, happiness without pain…in *The Wizard of Oz* gray is linked with hard work, scarcity, poverty, and death, while [colors] are associated with a world overflowing with commodities, with plenty of food, and with jewels and precious metals."[180]

An apparatus of advertising had emerged indeed, but also an apparatus of cultural production in which the dreams of abundance without scarcity were given real consideration which mirrored a culture increasingly enfolded within the interests of mass consumption. Leach then points to an important and emerging new philosophy of political economy that would add the necessary economic pretexts to a culture of self-fulfillment through an abundance of commodities.

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[179] Ibid, 497.

[180] Ibid, 445.

The economist Simon Patten was instrumental in developing "a positive approach to economics…departing from earlier laissez-faire ideas of scarcity and self-denial in favor of the more appealing notions of supply and prosperity."[181] A prolific writer from the 1880s to the early 1900s, Patten's treatises on economics from the perspective of abundance and the end of scarcity were highly influential in economically rationalizing the new consumer culture. Leach summarizes Patten's contribution as such: "For him, all was mind cure. He was America's most influential economist of capitalist abundance and consumption; his theories justified constantly rising levels of wishing and consumption and the creations of business strategies to drive the engine of consumption."[182] As a part of his economic analysis, Patten recognized the need for a cultural shift if this new economy of abundance was to pan out. He insisted "that a new structure of values was necessary to support this growing business civilization…[if] an economy changed radically, so, too, should the related culture; every vestige of the older culture that did not 'fit' rationally with the new material conditions should be discarded."[183] This new structure meant discarding the old notions produced by a religious and scarcity focused mindset of self-denial and ascetic living. Patten believed that by supporting the burgeoning corporate business climate through a reoriented culture of mass desire and consumption would end scarcity itself leading to a new age of abundance for humanity. For him, as Leach notes, "Americans were no longer living in primitive times. A new morality must be acquired to eliminate 'all checks to full enjoyment' and to allow people

[181] Ibid, 407.

[182] Ibid, 413.

[183] Ibid, 416.

to make rational choices."[184] In Patten's conception, a consumer consulter was inherently moral due to the concomitant rise in the standard of living. On Patten, Leach delves into the heart of the matter: "The factory-made goods, the department stores, the new corporate monopolies, the installment buying, the nickelodeons, the amusement parks—he saw all as examples of the new social surplus and of a new and improved humanity."[185] Happiness was to be found in higher incomes that afforded more consumption more accumulation of commodities.

3.5 A Sophisticated Apparatus

On the back of economic theories like those espoused by Patten, early twentieth century business practices were awash in centralization, monopolization, acquisitions, and mergers all fueled with capital from investment banks like Goldman Sachs. These practices continued the trend of rationalization wherein efficiency was king—efficient distribution, cheap raw materials, and investment and acquisitions that deepened market penetration. Leach explains: "Chains were centrally managed and depended on pooled buying and standardized advertising. Greater economies of scale were possible with chains. Their spread after 1920 followed a trend throughout the economy and signified a 'tremendous concentration' of economic power…in fewer and fewer hands."[186] Leach uses the term "mergermania" to describe the business climate of the 1910s and 1920s, and the corporate banking sector, especially investment banking, had much to do with facilitating such a large volume of

[184] Ibid, 418.

[185] Ibid, 416.

[186] Ibid, 476.

economic activity. He finds that the growth of investment banking was closely intertwined with the growth of mass consumption. Investment banks provided corporations with access to the stock market thus becoming eligible for the funds needed to expand, provided the economically technical and legal services required for mergers, and helped "[find] the capital for businesses to buy out their competitors."[187] These services led to massive consolidations and increases in business efficiencies while effectively creating corporate monopolies. Leach using the example of General Foods which was originally named Postum's after the owner. He writes that "[in] 1923 Postum owned five companies; by 1929 General Foods…operated fourteen companies, including Bran Flakes and Jell-O."[188] The investment bank Lehman Brothers assisted in these acquisitions because, as they saw it, it was inefficient for food salesman to focus on just one product thus acquisition became the road to economic efficiency and profit maximization.[189] All the while, even the investment bankers, understood the importance of maintaining an ever increasing desire for consumption in the American population. Leach writes of investment banking brokers and merger specialists: "As brokers they believed it was not the business of business to judge other people's desires. Quite the opposite: Business succeeded…only when business responded to desire, manipulated it, and extended its frontiers."[190] The banking institutions underwriting all of these mergers, acquisitions, and capital investments did so under the idea that consumption could be accelerated through an accelerating desire manufactured into mass consumer culture.

[187] Ibid, 480.

[188] Ibid, 484.

[189] Ibid.

[190] Ibid.

This sophisticated apparatus for selling commodities was mirrored by an equally effective system for ensuring consumption through the expansion of consumer credit and a fully professionalized advertising industry. As Leach puts it, "[greater] investment in mass production required skill in mass seduction, less reliance on amateurism and serendipity, and more sure-fire professional methods to guarantee turnover."[191] Large department stores had instituted mechanisms like charge accounts and paying in installments, while simultaneously reaching the apex of cultural touchstones through Thanksgiving and Christmas parades. The Marshall Field's department store's charge accounts "by the end of the twenties…had risen to 180,000 accounts—almost double the 1920 figure."[192] Any roadblocks to consumer consumption were being dismantled as throughput and guaranteed turnover took precedence in the American economy. Even as the Great Depression began, this apparatus was hard at work and mostly entrenched. Leach explains:

> "[Even] as the Depression began to deepen, Macy's gained the highest-volume turnover in its history, its parade, now in the national limelight. Ten bands marched in the 1930 parade on a cold, wintry day that was threatened by a heavy snowfall. Santa Clause traveled on a Zeppelin dirigible held down to the ground by men dressed as elves."[193]

Leach makes a point in the conclusion of his text that investment advertising, especially like those seen in parades, was less about the immediate impact on spending and more about "the need of business to have unopposed cultural influence."[194] Through an almost

[191] Ibid, 518.

[192] Ibid, 520.

[193] Ibid, 592.

[194] Ibid, 665.

incomprehensible array of cooperating forces, from the economic base and the divorce of production and consumption to the involvement of government and intensive advertising and the creation of a new highly consumer oriented socio-cultural sphere, a new highly commoditized spirit had taken hold of the United States, making it a land of desire.

Part 4: Plastic USA

The emergence of plastic as a ubiquitous and defining substance of post-WWII American modernity tracks closely with the rise of mass consumer culture. Jeffrey Meikle's American Plastic traces the development of the plastic industry from the late nineteenth century to the 1990s while focusing especially on the public understood and contextual used plastic. In it's early stages, plastics like celluloid (invented in the 1870s) were used to substitute and imitate more expensive materials like ivory and tortoiseshell. These imitations and substitutions as Meikle calls them came down to the bottom-line—i.e. it was cheaper to use plastic than traditional inputs. Seeing an opportunity to proselytize about more than just cheaper inputs, promoters of celluloid and other early plastics proclaimed that the road to a post-scarcity society had now been paved with cheap plastics. All could luxuriate in "tortoiseshell" glasses and "ivory" toilet ware, not just the well-off, through the power of celluloid.

The high-minded rhetoric surrounding plastic would only continue with Bakelite and the evolution of the plastics industry from imitation and substitution to innovation. This expansion meant familiarizing the consuming public with the possibilities of plastic and thus Bakelite's moniker "the material of a thousand uses." Bakelite had mostly been used for industrial purposes up until the 1920s when it became a household name[195] due to its molded

[195] Jeffrey Meikle, *American Plastic: A Cultural History,* loc 568

radio cabinets. Modernity was taking shape through plastic, and it's promoters couldn't help themselves as they declared humanity's official victory over nature—society had proved its dominion over nature with the synthesis of completely new, largely indestructible shapes.

In the post-war years, the plastics industry would move away from the hard and durable thermoset plastic's like Bakelite to thermoplastic's with their low cost and baked-in disposability. The time of creative go-getters like Leo Baekeland had passed in favor of huge, consolidated corporations like DuPont. The public perception of plastics, always a worry for players in the plastic industry, took a nosedive as science and chemistry became associated with the atomic bomb. A growing realism surrounding various plastics and their uses began to set in. The high-minded advertising and public demonstrations proclaiming the alchemical miracle of plastics gave way to what Meikle called "damp-cloth" realism—i.e., a focus on the convenience of cleaning plastic laminate countertops and tables.

The trends of monopolization, mass culture, and post-war capital investment intertwined to create an incentive structure in which the producers and suppliers of plastic contrived an astounding array of products. Thermoplastics, when properly disposed of as they were made to be, massively increased plastic throughout and became the engine of commodity turnover in America. The supply side pressure to find any and every niche possible for plastic to commodify had much to do with thermoplastics origins in petroleum. Celluloid, a natural plastic, is made from cotton and camphor. Bakelite, the first synthetic plastic, comes from coal tar. Thermoplastics come from creatively using the chemical by-products from refining petroleum to synthesize plastics cheaply and at vast scales. The post-war years were defined by their cheap energy in the form of oil and gas, and the plastics industry was intent on squeezing out any and all profits to be made from the "waste" of oil refining.

This section will examine the shifting image of plastic in the consumer consciousness as it developed from its early years as a cheap imitative substitute to a substance with more legible, realistic use cases for something new, innovative, and largely disposable in the post-war years. Modern industry's search for ever-cheaper inputs and ever-increasing throughput would be epitomized in popular thermoplastics like polyethylene, and in conjunction with an advanced mass consumer culture, would lead to a massive proliferation of plastic pollution with possible existential effects on the Earth-system.

4.1 Imitation and Substitution

The natural plastic celluloid appeared in the late nineteenth century and gained popularity as a replacement for ivory in billiard balls and toilet ware as well as replaced the tortoiseshell found in glasses and combs.[196] The two basic components of celluloid are cotton and camphor (the bark of a rare tree) which would be "pressed into blocks under heat and pressure"[197] which could then be molded into cheap commodities. While opening the eyes of industry to the potential development of new plastics, celluloid could not succeed the way future plastics would.

For one thing, celluloid, like the ivory and tortoiseshell it replaced, was dependent on increasingly scarce camphor.[198] The post-scarcity dreams of mass produced plastics could not flourish in a scarce material. Nonetheless, celluloid provided a rudimentary framework for how plastics could aid in democratizing the good life for all. As a cost-effective substitute,

[196] Ibid, loc 261.

[197] Ibid, loc 169.

[198] Ibid, loc 498.

Meikle finds that celluloid did indeed help democratize a slew of consumer goods for more and more people. He writes that "…for applications in which celluloid could and did substitute for ivory, the artificial material definitely served as a democratizing agent, making possible production of a much higher volume of goods at lower prices." The lowered prices are key here. Celluloid and plastics in general were developed under the logic of industrial capitalism which demanded a continuous search for cheaper inputs, increased labor productivity, and ever increasing commodity turnover. Meikle explains that celluloid "seemed attractive not because it extended the reach of human desire but because it allowed familiar desires to be fulfilled more easily and cheaply through substitution."[199] While the story of Bakelite would prove different, celluloid was not necessarily better than the materials it replaced only cheaper. Its failure to take over the cheap commodity production the way later thermoplastics would, was not only due to its scarcity, but the sheer physicality involved in its production. Meikle explains:

> "Plastic succeeded as a material of choice for manufacturing in the twentieth century not only owing to lighter, cheaper raw materials but because one-shot automatic molding operations eliminated the cost of separate fabricating, finishing, and assembling operations. But celluloid introduced no such savings."[200]

In essence, celluloid itself was cheaper than ivory or tortoiseshell, but still required intensive work from wage-laborers over an extended time made it still to expensive to aid in mass proliferation and accelerated turnover necessary for mass consumer culture. Despite its lower potential for mass production, celluloid—through its substitution and imitation—paved the

[199] Ibid, loc 271.

[200] Ibid, loc 384.

way for the likes of the Bakelite Company and the DuPont Corporation to reach consumers through innovation.

4.2 Synthetic Creation

The invention of Bakelite in 1907 marks a watershed moment in human innovation akin to the creation of nuclear energy. Through human ingenuity and inventiveness, the ability to create completely synthetic forms, "a substance with no direct analogue in nature"[201]signifies an unprecedented step in modernity. Leo Baekeland made the substance through a reaction between phenol and formaldehyde. It is vital to note that chemical phenol comes from coal tar—i.e., the waste of other processes becomes an integral part to creating the substance of modernity in plastic. Meikle summarizes contemporary feelings on the promise of Bakelite: "The human race stood at the beginning of unprecedented material abundance made possible by coal—dirty, black coal—one of the world's most aesthetically unappealing substances."[202] The promise of a post-scarcity society found new life in substances like Bakelite. This phenomenon would occur again with the rise of thermoplastics after World War II, which are derived from petroleum byproducts. Meikle stresses how plastics are much more than their discovery or creation, and to actually become the proliferate substances underpinning modernity they had to be contextualized. He writes: "But [Bakelite] did not become 'the first synthetic plastic,' a cultural as well as technological innovation, until its makers, promoters, processors, and users had incorporated it into the material would through a complex interactive process."[203] In other words, plastic as a reality

[201] Ibid, loc 590.

[202] Ibid, loc 1144.

[203] Ibid, loc 591.

in culture and society had to be introduced, promoted, and showed its ability to fit into a mass consumer culture. He continues: "Inventors of new materials had to define them. They had to persuade manufacturers to sue them in products and had to present them convincingly to the public…"[204]. As a completely new substance, the consuming public and traditional industry had to contextualize the substance, understand it, for it to succeed.

As a thermoset plastic, much of Bakelite's initial value came in its near indestructibility under most conditions making it more than a substitute in manufacturing processes but an actual improvement over traditional materials like rubber while also lowering production costs;

> "Just as Bakelite was superior to shellac, however, which often melted at high temperatures generated by dynamos…so too was it superior to hard rubber, which shrank, cracked, and deteriorated with age…Baekeland owed his material's commercial success to the fact that he immediately recognized it as superior to many other materials for many different applications."[205]

This superiority, combined with its penchant for cheap mass production, marks the arrival of Bakelite in the manufacturing scene as epochal. The material became indispensable to growing automotive and electrical industries,[206] thus aiding in the accelerating changes implied by *Land of Desire.* However, from its invention in 1907 to the mass popularity of Bakelite radios in the 1920s, Bakelite had to transition from replacement in industrial production to appealing directly to consumers.

[204] Ibid, loc 97.

[205] Ibid, loc 684.

[206] Ibid, loc 744.

The rise of consumer plastics in the 1920s came with promotions and advertising that proclaimed humanity's final dominion over nature or even humanity's ability to create substances more perfect than nature could hope to. Along with these notions was the idea that, through the power of chemical synthesis, nature would no longer need to be mined and destroyed—plastic production couched in the language of conservation. The focus on convincing consumers of the merits of plastic as opposed to just manufacturers meant a reimagining of plastic. This change included painting chemists as modern alchemists harnessing the mysterious power of chemistry to create real, useful substance out of waste.[207] Integral to Bakelite explosive rise in public consciousness was its radio sets. Meikle summarizes:

> "The Bakelite Corporation was benefitting from an increase in automobile sales and a large phenol surplus left from [WWI]. Even more important was radio's popular emergence. Military demand for radio sets during the First World War had strained manufacturing capacity, but the real boom came between 1920 and 1924, when civilian enthusiasts began assembling sets at home and scores of companies supplied read-made equipment."[208]

This transformation from a rubber and shellac replacement to consumer goods in the 1920s marks plastics real emergence as the *stuff* of a mass consumer society. Important as well to growing plastics consumption was the magazine *Modern Plastics*, basically an industry newsletter that was reimagined in 1934 now "promising 'to increase the use and consumption' of plastic, [the owner] in effect took away the industry's only means of internal communication and transformed it into a medium of advertising aimed at convincing other

[207] Ibid, loc 567.

[208] Ibid, loc 963.

manufacturers they could best attract consumers to their products by making them with plastic."[209] Plastic was becoming big business and increasingly a part of the sophisticated consumer apparatus aimed at increasing commodity consumption and turnover. Furthermore, Bakelite's consumer success with radios was a signal-fire inviting more and more companies to produce their own phenol-derivatives as well as encouraging research investment into new plastics. Meikle concludes that "[s]ophisticated advertising reached a public whose experience of the automobile, radio, and movies disposed it to a universal identity base don mass-produced goods rather than on regional tradition."[210] The plastics industry was increasingly reaching out to a population inclined towards mass consumption—a population that had been conditioned, as seen in *Land of Desire*, to see the value of commodity consumption especially as a wage-worker divorced from the productive process of one's own reproduction.

Much of plastic's value as a commodity from the 1920s to the 1940s came from its ability to attract. Consumer plastics introduced completely new shapes and colors to the public—they redefined the visual language of modernity and consumerism. An early competitor to Bakelite, Beetleware, which used urea instead of phenol in its synthesis, sold kitchen products like plates and cups in an awesome variety of colors. Meikle explained that "the new plastic dishes were introduced to the British market in 1925 but did not catch on until Harrods mounted a major display late in 1926."[211] Similarly, the department store Marshall Fields in Chicago sold an array of Beetleware molded drinking cups as

[209] Meikle loc 1605

[210] Ibid, loc 1048.

[211] Ibid, loc 1261.

"[b]usinessmen hoped industrial design would overcome the problem of underconsumption to which they attributed most economic woes."[212] Plastic's role in promoting mass consumption included more than just industrial use and attractive design. For example, it helped redefine grocery shopping for many by replacing metal parts in scales. The Toledo Scale Company which provided grocery scales nationwide from 1901 became concerned as grocers complained of the scales' weight, coming in at a whopping 163 pounds or 74 kilograms, preventing them from rearranging their stores.[213] In 1928, the owner of the company began to think outside of the box considering how non-metal parts could be used to decrease scale weight. By 1935, through investment in research, Plaskon had been developed and utilized which dropped the weight of scales to 55 pounds or 25 kilograms.[214] This decrease had an astounding effect on consumption. Meikle writes that "the [scale] could be lifted easily by salesmen and grocers…Sales increased by 300 percent in six months as grocers discarded cast-iron reminders of the general store era."[215] Plastic and the promotion, the inducement of consumption had become largely intertwined during the interwar years, and, of increasing importance was the role of large consolidated firms like the DuPont Corporation which pushed plastic to heights yet unseen. As seen in *Land of Desire*, the incredible pools of capital available to large, consolidated firms meant an increasing reliance on product turnover and throughput—i.e. these large investments in research and new products only worked economically if consumers continuously purchased increasing amounts of products.

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[212] Ibid, loc 1710.

[213] Ibid, loc 1901.

[214] Ibid, loc 1946.

[215] Ibid.

4.3 Nylon, Desire, and Realism

The monopolization of the plastics industry under giant chemical corporations tracked with the pattern of consolidation characterizing the early twentieth century American economy discussed in *Land of Desire*. Meikle discusses how "[through] a policy of expansion that began in 1910 and continued into the 1920s, DuPont shifted its focus from explosives to chemicals by acquiring established companies…"[216]. These acquisitions, discussed as an at-large phenomenon in *Land of Desire*, provided the scale necessary for capital investment into pure research with possible merchandising applications. While DuPont became a big player in celluloid, it really took off in the plastics market with the creation of its artificial fiber, nylon, that would go on to rival and exceed natural silk in many respects. The synthesis of nylon marked another watershed moment in the plastics' s industry and thus modernity. Meikle indicates that in 1907 Leo Baekeland had no clue as to the actual chemical composition of his creation Bakelite,[217] and this would change with the creation of corporate labs with the resources to approach designer materials synthesized to precise specifications. Meikle summarizes the phenomenon: "Meanwhile, the new field of polymer chemistry became more theoretical in approach. Trial-and-error entrepreneurs like Baekeland yielded to younger chemists employed by large chemical companies…"[218]. With the success of these operations, especially DuPont's success in developing the first artificial fiber, the dramatic rhetoric of man's final dominion over nature became the norm in press

[216] Ibid, loc 511.

[217] Ibid, 699.

[218] Ibid, loc 1280.

releases, advertising, and at practical demonstration events like world fairs. These proclamations, however, were not well received by the consuming public. Meikle explains: "When DuPont began introducing nylon in the form of women's stockings, however, the company found that its scientifically oriented promotion provoked misunderstanding, even active distrust."[219] Nylon, announced by DuPont in 1938, created a consumer frenzy despite its heavily science-focused marketing.

The scientific ingenuity necessary to create artificially polymers should not be underestimated. Harry Carothers, largely considered the inventor of nylon, began his research in 1928 making it a decade between inception to product announcement. As Meikle explains, establishing a synthetic fiber for women's stockings to rival those made of silk meant "perfecting a host of discrete physical operations—melt, spinning, pretwisting, draw twisting for strength, uptwisting for elasticity, shrinkage removal, sizing to protect filaments during further processing, spooling, knitting, preboarding, of stocking to prevent wrinkles, dyeing, and so on." [220] The long development cycle behind the creation of nylon and specifically nylon stocking was only possible through the capital investment from a large consolidated firm like DuPont. Nylon stockings became a runaway success leading up to WWII. With much fanfare in newspapers and popular media preceding its arrival in stores[221], nylon had a reputation that preceded it which it could not live up to as the stockings were not indestructible or as strong as steel, as some media claimed. Meikle explains that, despite not living up to these impossible standards, it was the realistic applications, convenience, and lower cost which made nylon a success; the following excerpt surmises the situation clearly"

[219] Ibid, loc 2039.

[220] Ibid, loc 2182.

[221] Ibid, loc 2250.

> "Recognizing the danger of such extravagant claims before nylon even reached the marketplace, DuPont tried to get out of its 'embarrassing position' by scaling back the announcement's original terms, especially the notion that nylon possessed the strength of steel…Even so, by giving nylon a domestic role that ordinary consumers could understand…[like] eliminating one of life's minor irritations and saving some money in the process proved more compelling than molding a synthetic utopia. Although nylon did not go on sale across the country until May 1940, American women eagerly awaited indestructible stockings."[222]

This trend continued into the post-war years as the hyperbolic claims of the plastic industry focusing on alchemy and dominion yielded to realistic notions of plastic's use cases. Nylon's success in the interwar years was absolutely marked. DuPont converted to military production in 1942 and "supply officers soon realized it was superior to silk in strength, resilience, and resistance to mildew and salt water."[223] Nothing indicates nylon's success in the consumer market like the nylon riots of 1945. After being introduced for pursued in 1940, only two years later there was no nylon to be had as it was mostly diverted for military production. When it returned to the market in 1945, consumers could not contain their excitement. In September of 1945, reports appeared explaining how "small shipments of stockings went on sale in limited number of stores, all besieged by mobs of people who had learned of the offering by word of mouth. The riots continued through the middle of 1946, as long as the shortage remained severe, wherever and whenever nylons went on sale."[224] A

[222] Ibid, loc 2265.

[223] Ibid, loc 2373.

[224] Ibid, loc 2394.

superior product to silk while being cheaper to produce and purchase solidified nylon's place in the hierarchy of consumption under mass culture.

The trend of presenting and understanding plastic realistically as opposed to fantastic associations of chemistry as magic continued and expanded into the post war years in America. The consumers of the post-WWII era in the United States had become familiar with plastic as a material, but increasingly demanded a more domesticated less scientific presentation of plastic products.[225] Associations with chemistry and science, especially after the dropping of the atomic bombs in Japan were exceedingly negative following the end of WWII.[226] In plastic, one finds a perfect manifestation of the separation of the production and consumption Leach discusses in *Land of Desire*. Without any traditional analogues in nature and a production process steeped in technical expertise far removed from day to day experience, the plastic industry had to deal with plastic's alien nature. Meikle writes: "Domesticating plastic offered the consumer a means of taking control of new synthetic materials whose entire processing…otherwise revealed a colonizing of scientific and technical values upon the material realm of everyday life."[227] This was a two-way, dialectical process as consumers interacted with and ultimately used plastics taking it from the realm of fantastic scientific achievement to a large mundane, useful material. Meikle identifies the popularity of "damp-cloth" cleaning as an illuminating example of the trend.

Plastic's place in a mass consumer culture depended on convincing consumers in post-WWII America of its merits. The plastics industry began emphasizing a realistic outlook on their products. In 1947, the SPI (Society of the Plastic Industry), an association for promoting

[225] Ibid, loc 2029.

[226] Ibid, loc 2025.

[227] Ibid, loc 2029.

the industry's interests, collaborated with the magazine *House Beautiful* to make a special issue titled "Plastics..A Way to a Better More Carefree Life" which made a strikingly down to earth appeal for day-to-day plastic use. Meikle summarizes their argument:

> "Neither 'miracles' no 'junk,' synthetic materials would 'improve your life a thousandfold IF you know what to expect of them.' To get the most from them, people had to 'forget the dream world stuff you've heard about plastics and learn what they really are and what they can really do for you.'"[228]

This argument coalesced into the magazine's enthusiasm for "damp-cloth" cleaning which emphasized how easy laminated countertops and tables were to clean. The magazine and the industry were appealing to mundane, domestic convenience.[229] In the coming age of thermoplastics, convenience would manifest as disposability as supply pressures generated the conditions for high turnover and massive throughput.

4.4 Thermoplastics and the Pressure of Supply

The post-WWII period in the United States marks another turning point in plastic's development with the meteoric rise of thermoplastic production. The numbers behind general plastic production paint a vivid picture of the growing scale of the industry: "In 1939, before the war, American companies produced 213 million pounds of synthetic resins. Two years later…output doubled to 428 million. By 1945 annual production double again to 818 million pounds, and it reached 2.4 billion pounds in 1951."[230] The consistent growth in plastic production meant American consumers were being continually inundated with plastic

[228] Ibid, loc 2726.

[229] Ibid, loc 2738.

[230] Ibid, loc 1994.

products—which poses a problem for industries dependent on continuous, growing consumption under the dominant form of capital relations in mass culture. Convincing consumers of plastic's domestic merits was only half of the battle; consumers had to be pushed into a world in which disposability became the defining trait of plastics. This aspect meant a focus on convincing manufacturers of the benefits of the newly developed thermoplastics when it came to lowering production costs and facilitating turnover. The post-WWII period increasingly meant a removal of choice for consumers in the sense that, over time, the commodities they depended on depended themselves on cheap, disposable thermoplastics derived from petroleum by products. Meikle explains how an editor of *Modern Plastics* in 1952 saw damp-cloth realism and other outreach toward consumers as mostly unnecessary; "It was a waste of money because plastic's image—good or bad—did not really matter. The key to plastic's success, as he saw it, was always 'selling to the manufacturer.' Once plastic products filled the stores, people had not chose but to consume what they were offered."[231] Thermoplastics would come to symbolize the absolute success of these efforts in the post-WWII period in the United States.

While thermoset plastics, such as Bakelite and others useful for industrial manufacturing, were defined by their near indestructibility, thermoplastics became defined by their inherent flimsiness. Meikle writes that "[as] thermoplastics they lacked Bakelite's hardness and were sensitive in varying degrees to heat, chemicals, water, and sunlight."[232]

The structural weakness of thermoplastics came with attractive structural advantages economically. Thermoplastics like polystyrene or polyethylene could be injection molded in

[231] Ibid, loc 2767.

[232] Ibid, loc 2670.

one shot quickly—as in a matter of seconds—as opposed to the tens of minutes needed to mold similar thermoset plastics.[233] The economic advantages in terms of increased labor productivity and throughput are clear. However, even if manufacturers dominated the land of commodities with plastics, consumers had to be cajoled into understanding new thermoplastics as disposable.

The key chemical for creating celluloid was derived from cotton. The essential chemical for synthesizing Bakelite comes from coal tar. The essential chemical for synthesizing thermoplastics comes from petroleum, and it is this connection that so allowed for a cheap and massive proliferation of plastic commodities in the post-WWII years and beyond. Cheap raw materials in the form of byproducts from cheap energy processing made thermoplastics a perfect companion to the now maturing American mass consumer culture. Meikle summarizes the situation brilliantly:

> "Plastic became the material of choice for this never-ended expansion. It was inexpensive because it was derived from an endless supply of petroleum. It was less solid or intractable than wood or steel. It was free of traditional preconceptions regarding its use and could be molded into any shape a restless drive for novelty might conceive. It was, finally, so lightweight and in some forms so insubstantial as to be discarded without a second thought. Plastic not only offered a perfect medium for this material proliferation. It conceptually embodied it and stimulated it."[234]

The low cost of manufacturing combined with thermoplastic's guise of immateriality made it a substance well suited to be disposed of and bought again continuously without a second

[233] Ibid, loc 1345.

[234] Ibid, loc 2787.

thought. Important to note is how much this phenomenon was driven by manufacturers and supply pressure and not by consumer demand. Manufacturers had "an overabundance of chemical raw materials waiting to be exploited,"[235] meaning a need to push new ways of consuming to the American public. Disposability and turnover became the defining trait of plastics as their low cost of manufacture and overabundant supply meant profitability depended on continuous consumption. This phenomenon can clearly be seen in the thermoplastic polyethylene and its use in making both ephemeral products and packaging.

Encouraging consumption was a priority for both the government and industry in post-WWII America and thermoplastics helped much in that regard, especially polyethylene. Polyethylene, described by Meikle as the first plastic of mass production, comes of course from the synthesis of petroleum byproducts, and it became the very stuff of American modernity, conditioning consumers to approach certain plastics as easily disposable and replaceable, especially when it came to packaging. Meikle summarizes the turning point:

> "Polyethylene was so successful that a designer urged Proctor & Gamble to use it for Crisco shortening…[polyethylene] fell rapidly in prices, and cheap blow-molded thermoplastic bottle were soon used for detergent, bleach, milk, sauces, and condiments…by 1956 [promoters] were celebrating disposability as 'an important key to continuing volume.'"[236]

Through packaging, polyethylene attained dominance in overall plastic production and became a material absolutely ubiquitous under modernity. The economic relations underpinning mass consumer culture maintained and accelerated profits through massive volume and throughput. From a materialist perspective, thermoplastics encouraged their own

[235] Ibid, loc 1355.

[236] Ibid, loc 2963.

disposability through the substance itself, and through the reality that one could buy an identical bottle or container easily and cheaply. Meikle explains that disposed of plastic pens, razors, bottles, and packaging were "miraculously renewed each time an identical replacement appeared. The repetitive act of throwing away costs its meaning in the face of a more insistent stability through instantaneous replacement."[237] Life under the domination of thermoplastics meant consumers, separated as they were from production and induced as they were towards mass commodity consumption, became *disposers* as simple commodities could be continually and easily replaced.

Part 5: Conclusions

The texts of Foster et al. and Moore discussed earlier in this article provided the foundation for understanding capitalism's dialectic with nature as it operates upon, with, and through it. These texts also offer a valuable framework for understanding the proliferation of plastic pollution and how to understand the phenomenon as a dialectical relationship in which plastic works through nature, and nature works through plastic. The over proliferation of plastic pollution, especially marine plastic pollution, represents a growing metabolic rift in the dominant geological order of the Holocene. Plastic has proved to be the perfect homunculus of an economic system dependent on ever-growing commodity accumulation, and the Earth-systems inability to metabolize the vast amount of plastic waste (at least in the short and medium run while in terms of the long durée there is much uncertainty) combined with the social inability to monitor marine plastic pollution have coalesced into a metabolic rift. This article has investigated the origins of the rift which are to be found in mass consumer culture—a culture that once promised the end of scarcity has proliferated waste to

[237] Ibid, loc 4413.

such a degree as to upset and imbalance the natural systems of reproduction that underpin the dominant conditions of the Holocene. The massive proliferation of plastic waste in the environment and the overloading of natural sinks for waste should be understood as an epochal, world-remaking event in the vein of sudden geological change similar to the eruption of a super volcano or the impact of a large meteor. Biologist Barry Commoner's 1971 work *The Closing Circle* offers a clear and prescient explanation as to why plastic proliferation presents an epochal change in the Earth system, and why exactly it had produced such a rift. He writes:

> "Ecologically, synthetic polymers are literally indestructible. And, as in the case of natural polymers, there are no other natural agencies capable of degrading polymers at a significant rate…They are, therefore, ecologically non-degradable….the ecosphere is increasingly cluttered with plastic objects nearly infinite in their shape an size, they will—through the workings of nature and laws of probability—find their way into increasingly narrow nooks and crannies in the natural world."[238]

In the following forty years of plastic accumulation that followed Commoner's book, plastic did indeed fulfill this promise. Disposability in the economic sense has little to no connection with metabolizability in the natural sense. Once signifying humanity's final dominion over nature, the plastic age has increasingly begun to signify a divorce from nature—a rift created by the synthetic substances of mass consumption. The Anthropocene represents not dominion and control but rather an inability to properly situation human activity within the larger patterns of the Holocene. Time scales are of high relevance here. Plastic packaging and products increase the profitability of petroleum processing while being necessary for the

[238] Barry Commoner, *The Closing Circle: Nature, Man, and Technology* (New York: Knopf, 1971), digital epub, 91.

movement and massive turnover of goods within consumer culture. Plastic is a lubricant for the dominant economic system—a way to continue accumulation, however short-sightedly. The reproduction time for capital relations continues to become shorter while the time it would take for the Earth-system to metabolize or incorporate plastic remains in the long duree. Meikle writes: "But in a supreme irony, while a fast-paced lifestyle led people 'to cry out for more and more of these throw-away objects,' such things had become 'more durable than ourselves, our governments, and our society.'"[239] The time scales at which plastic operates means it comes with vast uncertainties. Plastic itself is not an issue, but its over-proliferation, which only really started with the rise of thermoplastics in the 1950s and beyond. In terms of plastic's own conceivable lifespan, it has *just* arrived on the scene. How the Earth system will incorporate plastic in the long durée remains to be seen, but in any case, it represents a clear divorce from the business as usual Holocene. Moore's analysis in *Capitalism in the Web of Life* offers a concrete way of understanding the problem on capitalism's own terms while *Ecological Rift* offers a framework for understanding the larger dialectic at play.

5.1 Plastic Commodity Fetishism

An as of yet unexplored aspect of plastic in this article has to do with commodity fetishism. As seen in *Land of Desire*, the separation between production and consumption precipitated by growing monopolization and the mass movement of people from farming into wage-work leaves has meant an almost complete ignorance of the process by which the commodities they consume are created. Using a quote from Edmund Wilson in 1930, William Leach's *Land of Desire* makes clear the repercussions of this divorce:

[239] Jeffrey Meikle, *American Plastic: A Cultural History,* loc 3553.

> "'The capitalist system makes it very much easier for people not to realize what they are doing, not to now about the danger and hardship, the despair and humiliation, that their way of life implies for others.' By 1910 more and more people were less and less aware about how tings were made and who made them…the separateness of consumption made it easy to deny the suffering…This separate commercial culture was, then, an awesome creation."[240]

An awesome creation indeed. While Edmund Wilson could not have known the thermoplastic revolution was coming, and Leach was speaking generally about capitalism, it applies strikingly well to plastic proliferation. Consumers have little idea of the repercussion of their consumption. If they do, they have little choice or control because consumption and production have been so separated while constantly induced by the culture at large to continue consuming commodities. Moore indicates the meat-industrial complex as another instance of this phenomenon. He writes: "Today's meat-industrial complex…would be unthinkable to those living in an earlier era of capitalism when the human relation to non-human nails was—symbolically and materially—more direct and intimate."[241] Similarly, this article has shown that the way consumers interact with and dispose of plastics is a historically specific cultural formation stemming not only from the rise of mass culture but dependent on conditions of cheap energy and raw materials.

The underlying logic behind capital accumulation, that is in Marx's conception M-C-M' in which money is transformed into more money through the commodity, belies any concern with sustainability or metabolizability in the natural sense—the one dominating concern is the accumulation of capital. It is the animating force behind the plastic rift

[240] William Leach, *Land of Desire*, 261.

[241] Jason W. Moore, *Capitalism in the Web of Life*, 456.

understood as an over-accumulation of waste out of sync with any processes for metabolizing the waste. Plastic proliferation resonates well with Foster et al.'s reworked concept of the treadmill of accumulation. The conditions and economic logic which have led to plastic proliferation are hundreds of years old. As you might recall, Foster et al. found the notion of a treadmill of production unsatisfactory due to its focus on scale over relations. The scale of plastic production and accumulation is indeed at issue, but it is the logic underpinning this massive scale and production that should be indicted. Capital, understood as self-expanding value, sees no borders, no boundaries. Under these assumptions, the supply pressures emanating from the vast amounts of cheap petroleum byproducts leading to the bombardment of consumers with thermoplastics make sense. While these products provided use to their end consumers, the real value from a systematic perspective was their ability to increase and accelerate the process of capital accumulation. As thermoplastics are derived from petroleum byproducts, the plastic rift can be understood as not only a boundary crossed under the novel entities guidance from the Stockholm Institute, but it can be situated within the large rift in the carbon cycle. Moore's concepts of ecological surplus, cheap nature, and the closing waste frontier offer a way for contextualizing the plastic crisis within capitalism's own terms.

5.2 Cheap Taps, Cheaper Sinks

These historical shifts in plastic production from depending on cotton, to coal tar, to petroleum byproducts are manifestations of the system's hunt for cheap nature, as Moore would call it. By finding profitable uses for what would have been waste or untapped nature, the capitalist system has been able to increase the rate of appropriation faster than that of capitalization. Moore's breakdown of the process is reproduced here in full:

> "…capital's priority has been to reduce the value share of raw materials relative to machinery while increasing physical throughput. This drives down the value

> composition of production even as its technical composition rises. Hence the centrality of frontiers of appropriation—commodity frontiers—though the history of capitalism. Not only has capital sustained itself on the basis of Cheap inputs, but by revolutionizing the socio-ecological relations of production on a system-wide level, it has restored and recreated an expanded ecological surplus. Fossil fuels have been central to this ecological surplus for the past three centuries. But these energy sources did not make capitalism so much as capitalism remade itself through their incorporation."[242]

Capitalism has incorporated fossil fuels into more than just cheap energy as they are the very basis—the constituent element—of over-proliferated plastic commodities. This has increased the world's ecological surplus by intensifying the appropriation of nature by commodifying it in every aspect possible. These appropriations, however, have only been possible through a rationalized, technocratic understanding of abstracted social nature. Moore understands that intensifying the appropriation of nature "turns on the production of abstract social nature: produced through the biopolitical, geographical, and scientific-technical knowledge and practices necessary to secure the conditions for renewing the Four Cheaps."[243] The development of the plastic industry falls neats within this paradigm as it depended heavily on technical knowledge combined with a cultural sphere that demanded and induced the consumption of ever increasing quantities of commodities to squeeze any and all appropriations to be had. Technical know-how meets a land of desire to create the conditions for plastic proliferation and accumulation completely unbound—nature, abstracted, becomes a tap providing capital the resources for its self-reproduction. Furthermore, the idea that

[242] Ibid, 338.

[243] Ibid, 471.

thermoplastics, which will persist in the environment on the scale of thousands of years, are in fact, *disposable* is a concept that could only exist under the auspices of a completely abstracted social nature. Here as well, plastic commodity fetishism is at play. Thermoplastics are disposable in solely an economic sense, however, they are not metabolizable in a natural sense. Therefore it is fair to assume a disconnect exists in how the capitalist system understands thermoplastics and how the Earth's systems receive them.

As mentioned earlier, the temporal disconnect between the reproduction time of the productive forces of capital relations and the reproduction time of natural conditions plays an important role in explaining the plastic rift and growing exhaustion of the dominant relations of capital, especially as it relates to plastic and the closing of waste frontiers. As a part of the Cheap Energy regime, thermoplastics have enjoyed high rates of appropriation compared to capitalization due to the fact that they are created from the waste products of petroleum processing. However, this has resulted in a non-linear accumulation of costs that have only become apparent in the last fifty years largely due to the legacy of 1970s environmental movements. Moore explains: "These spatio-temporal compulsions drive capital to accelerate the extraction of work/energy, but at the cost of destabilizing the webs of relations necessary to sustain rising physical output."[244] Again, thermoplastics provide an apt example of this phenomenon in motion. As the compulsion to accumulate more capital progresses, it has necessarily led to an over-accumulation of plastic waste in the biosphere, which in turn becomes a destabilizing force threatening business-as-usual capital relations that have dominated across the twentieth century's accumulation cycle. Nature's inability to metabolize plastic on a time-scale that would suit the further proliferation of plastic (let alone that which

[244] Ibid, 340.

has already accumulated across the biosphere) epitomizes this contradiction and is an example of Moore's "negative value."

As mentioned, under Moore's analysis, abstracted social nature leads to the operationalization of nature as either taps or sinks. The tap for plastic is clear—cheap petroleum production has allowed for a virtually endless stream of thermoplastics into the consumer world and then across the biosphere as waste. Natural sinks for plastic—i.e., the waste frontier—have become overloaded, seen clearly in the vast amounts of both micro and macro plastic particles in the oceans. The closing of the waste frontier signifies a level of negative value within the dominant capitalist mode of production that may prove to be an intractable problem. Plastic, even thermoplastics, in and of themselves do not pose an existential threat to the capitalist system or the world-system at large. Their *proliferation*—the sheer volume and scale of plastics—that have lead to a visible closing of the waste frontier. Following *Ecological Rift*, an analysis of the massive proliferation of plastics cannot stop at scale and volume. The underlying logic behind plastic proliferation—its existence within a mass consumer culture defined by capitalist productive relations wherein capital can be understood as self-expanding must—that proves the most powerful explanation for the closure of waste frontiers and the end of what Moore calls "cheap garbage." The intractability of the issue poses another consternating issue. Moore writes:

> "…climate change poses a fundamental challenge to the old productivist model. That challenge has to major expressions. The first says that production systems must internalize waste costs…[the] second says that internalization of waste costs cannot be offset through new Cheap Nature strategies that are themselves highly polluting. In other words, any effective response to climate change will have to go forward without the myth—and practice—of unpaid work and unpaid waste."[245]

[245] Ibid, 610.

Moore's work shows capitalism's strongest characteristic: its ability to shift, evolve, and transform in an effort to increase the rate of appropriation over the rate of capitalization. However, what happens when there is nowhere else for capitalism to turn? The crisis of modernity is perfectly manifested in the closing waste frontier as capitalist relations have little hope of solving the issue.

Moore challenges the notion of metabolic rifts, preferring instead the idea of metabolic *shifts*. This idea makes a certain sense as the Earth itself is not at stake but the dominant patterns of the Holocene. However, to *Ecological Rift*'s credit, the idea of a metabolic rift makes sense when considering the problem under the parameters of the Holocene. This article takes the position, especially in regard to plastic pollution, that one can consider them as *transformatory rifts*. The closure of waste frontiers implies a finality that applies most in an economic sense. In nature, the closure of socioeconomic waste frontiers does not mean a disappearance but a transformation. As the biosphere accumulates plastic, both plastic and the biosphere will take on new dimensions in the very long run. Moore's concept of the "double-internality" of society and nature helps make this phenomenon clear. Focusing on the idea of a transformatory rift means understanding how plastic operates through nature and how nature operates through plastic. As seen before the study from Villarrubia-Gomez et al., plastic is more than an inert pollutant but a factor affecting the unfolding of natural phenomena. Their report states:

> "Plastic has been found to host harmful algal bloom species, viruses, and microbial communities, increasingly recognized as the 'Plastisphere.' It is a vector for transport of alien invasive species…[regardless] of its size, then, each plastic particle has the ability to transport living organisms and to redestribute harmful

> substances, altering ecosystem compositor and functioning, and changing genetic diversities. *These properties cannot be inactivated*."[246]

Again, the temporal dimension at play cannot be emphasized enough. These plastic particles will linger virtually forever with no technologically feasible way of extracting them. Plastic proliferation, then, must be understood as a world-transformation in the making. It is so rife with uncertainty precisely because, with plastic's virtually limitless timescale, the process has barely begun.

5.3 The Myth of Consumer Responsibility

This article has noted how the dominance of thermoplastics in the post-WWII American economy was instigated by supply side pressure. Promoters of plastic began to focus on manufactures as opposed to convincing consumers of plastic's benefits. Once thermoplastics dominated production due to their inherent low-cost consumers had very little choice but to consume them. As seen in *Land of Desire*, consumers are less rational individuals voting with their dollar and more like lab mice in an elaborate and bountiful maze with bureaucrats, business brokers, and advertisers painstakingly recording every nibble of cheese, and if not consumed appropriately, then more energy will be expended investing in alluring configurations to stimulate demand for. Decades before thermoplastics were first synthesized, a sophisticated apparatus joining government and business had been developed solely for the purpose of manufacturing desire in consumers for more and more commodities. The separation of production and consumption in the United States, with roots originating as far back as the nineteenth century, means wage-workers must depend on the products that manufacturers provide for sale. Meikle explains: "If manufacturers used plastic-whether for

[246] Patricia Villarubia-Gomez, Sarah Cornell, Joan Farbes, "Marine Plastic Pollution as a Planetary Boundary Threat," *Marine Policy* 96, October 2018, 213-220

versatility of design, durability, lower cost, greater profit, or whatever reason—then consumers had no choice but to go along. Even those who thought they despised plastic would buy it and use it, often without recognizing it."[247] One would be hard-pressed to make their own non-disposable razors, shampoo bottles, shower curtain; this is not to mention the fact that buying these commodities in the form of traditional materials means taking on an extra cost burden which is antithetical to a consumer society. One might take exception to this claim due to the rising popularity of shops that allow consumers to bring in their own containers for typically plastic-packaged products, but this presents the problem of scale. This solution, under the dominant relations of capital, is not scaleable and thus no solution at all. Foster et al. write: "We are led to believe that if consumers—meaning the mass of population—can be restrained or their appetites rechanneled all will be well."[248] This thinking implicates the crisis solely in the direction of consumers who have little choice as it stands but to consume what is made available by manufacturers. Foster et al. make the salient point that interactions with nature begin with production and not consumption,[249] and thus that is where the prime responsibility lies. In other words, consumption and consumerism, in general, is downstream from the relations of production. Meikle continues:

> "The entire system of marketing, in which trillions of dollars are spent on persuading individuals to buy commodities for which they have no need, and no initial desire, would have to be dismantle if the object were to generate a genuine ecology of consumption…[it] is not a system for expanding choice but for

[247] Jeffrey Meikle, *American Plastic: A Cultural History,* loc 4277.

[248] John Foster et al, *The Ecological Rift*, loc 5799.

[249] Ibid, loc 5865.

controlling it in the interest of promoting ever-greater levels of sales at higher profits."[250]

A solution tenable under the dominant relations of production and consumption must necessarily increase profits and commodity consumption, thus making a "slow-down" in consumption an impossibility as long as the dominant logic of capital relations remains. A return to traditional materials while maintaining the same level of productive throughput is, of course, an impossibility. Many stakeholders, especially thinkers associated with the school of reflexive modernity or ecological modernization, hope for a solution to be found in accurately pricing in natural inputs—i.e. accounting and paying for what was once Cheap Nature. This too, smacks of impossibility. Both Moore and Foster agree that a call for capitalism to account for its inputs accurately is functionally identical to calling for the end of capitalism itself; Moore writes: "To call for capital to pay its own way is to call for the abolition of capitalism."[251] For Moore, the engine of capitalist development itself rests on not fully paying its costs, so the idea of "pricing in" nature produces yet another contradiction.

5.4 Garfield Demystified

The genesis of plastic over-proliferation can be found in the relations of production under mass consumer culture that necessitates an ever increasing consumption of commodities. Through its development and the eventual emergence of its thermoplastic form, plastic has greatly aided the imperative to squeeze any incremental amount of profits to be had within an accumulation cycle. The plastic Garfield phones that invaded the beaches of Brittany, France are the physical manifestations of a closing waster frontier and a widening

[250] Jeffrey Meikle, *American Plastic: A Cultural History,* loc 6077

[251] Jason W. Moore, *Capitalism in the Web of Life*, 337.

rift in Earth's metabolic processes. This article investigated the underlying logic which would make the invasion of plastic cat phone's legible. Capital's imperative to expand value by chasing profits eventually led to a separation of consumption and production for the average person leading to the rise of wage workers. Wage workers, with salaries rising along with the surplus capital of consolidated corporations, were assaulted with a flood of commodities. A sophisticated apparatus developed over the early twentieth century in which government, businesses, and social institutions all encouraged a burgeoning mass consumer culture. Plastic appeared as this process was underway, and proved to be a perfect vessel for increasing commodity consumption and turnover.

The accumulation of plastics in the environment and closure of waste frontiers implies a time of rising capitalization which means a search for new appropriations must be underway for capital relations to continue their evolution towards growth, intensification, and profitability. Unlike the discovery of cheap food in the American heartland that pulled England and Europe out of economic malaise in the early twentieth-century, there appears to be a dearth of opportunities for reconfiguration. This applies especially to waste frontiers—the accumulated waste plus the waste currently being produced can do little but amass and generate more cost, more uncertainty. As Moore points out, opportunities for appropriation in the natural world are dwindling, presenting a crisis for capitalism. More than a crisis for capitalism, plastic proliferation has introduced a transformatory rift in the dominant patterns of the Holocene meaning, epochal change for the environment at large. This article has been about the impossibility of making something from nothing—the impossibility of creation without cost. Separation from or dominion over nature narrative obscures humanity's position within nature as society operates upon nature, and in turn nature operates through society.

Who knows what became of the plastic phones after they were collected from the beach. Regardless of their actual fate, these thermoplastics without use-value but with a longevity almost unthinkable were taken from one closing waste frontier to another. Approaching this problem within the confines of the dominant mode of capital relations seen for the last few centuries in capitalist economies approaches asking for the impossible. Equally, Foster et al.'s call for a revolution of these relations based on creating a balanced ecology with nature seems just as far-fetched. However, understanding the problem is not as uncertain or controversial. Plastic proliferation should be understood as a world-transforming ecological process that has just begun. Thermoplastics have only been on the scene since around the post-WWII period and will far outlast anything on a human timescale. Plastic is part of a new geology, a new environment with unpredictable repercussions and transformations for the Earth system at large.

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