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AN ENVIRONMENTAL HISTORY OF THE RIO GRANDE IN THE PANAMA
CANAL ZONE, 1521- 1950

By

Francisco Javier Bonilla
B.A., University of Louisville, 2013

A Thesis
Submitted to the Faculty of the
College of Arts and Sciences of the University of Louisville
in Partial Fulfillment of the Requirements
for the Degree of

Master of Arts
in History

Department of History
University of Louisville
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May 2016

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A Thesis Approved on

April 15, 2016

By the following Thesis Committee:

Dr. Christine Ehrick

Dr. Randall Dills

Dr. Guillermo Castro Herrera

DEDICATION

For their continued support, encouragement, and love, I dedicate this thesis to my
parents in Panama

Sandra Garcia and Francisco Bonilla

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As with any project of this scope, there are a number of people whose insight, support, and encouragement have contributed to the completion of this thesis. For the past year and a half I have devoted a large part of my time to understanding the history and built environments of my hometown of Panama City. Countless professionals, relatives, friends, and acquaintances have helped me better understand its past, especially the many ways in which the influence exerted by the Panama Canal has shaped the lives of its citizens over time.

When I started working on this project, I was an undergraduate in the History department. The support and example provided by John T. Cumbler have greatly helped me become a better person and scholar. In addition, professors Christine Ehrick, Randall Dills, Mark Blum, Yuxin Ma, Brad Bowman, Daniel Vivian, Glenn Crothers, and many others from the History Department have helped me become a fairly competent historian. My time as a Graduate Assistant at Gottschalk Hall have enabled me to build better relationships with the entire History Department, especially with my daily companions Lee Keeling and Robin Carroll and co-workers Sarah Dunn, Wes Cunningham, and Hannah O'Daniel. Professors from other departments such as Margath Walker, Gabriela Stocks, Carol Hanchette, Jasmine Farrier, Avery Kolers, and others have helped make undergraduate and graduate careers at the University of Louisville have enriched my time at the University of Louisville.

Ultimately, I would like to acknowledge the pivotal role in my education played by the University of Louisville's international partnership with Quality Leadership University in Panama City, Panama, which allowed me to complete my undergraduate studies at Louisville, and led me to pursue a graduate education at the same institution.

ABSTRACT

AN ENVIRONMENTAL HISTORY OF THE RIO GRANDE IN THE PANAMA CANAL ZONE, 1521 —1950

Francisco Javier Bonilla

April 15, 2016

This thesis is an examination of the history of environmental change in the defunct Rio Grande river valley in the former Panama Canal Zone. By mining secondary sources and engineering records, this study provides a narrative of the historic river's role in the formation of the so-called interoceanic corridor through the isthmus of Panama from 1521 to 1950. More importantly, however, as a case study of river histories in Latin American environmental history, this understudied, Pacific-draining river illustrates how culture and non-human nature made Panama's strategic transit region into a loci for material flows over time.

The Rio Grande played a vital role in the establishment of the Spanish colonial mule road during the colonial period. The nineteenth century ushered in the industrialization of the corridor, initiated with the construction of the Panama Railroad by American capitalists. Great advances in hydraulic technology led to the first serious canal building efforts in the area, with the French effort succumbing to an unyielding nature. The Panama Canal, built by the US government, led to a radical reorganization of the area's socioecological systems. This thesis applies the concept of social metabolism and the 'cultural landscape' to understand material change in central Panama.

TABLE OF CONTENTS

| | PAGE |
|--|------|
| ACKNOWLEDGMENTS | iv |
| ABSTRACT..... | v |
| INTRODUCTION..... | 1 |
| HISTORIOGRAPHY AND THEORY..... | 6 |
| CHAPTER I NATURAL HISTORY AND PRE-COLUMBIAN CORRIDOR..... | 20 |
| CHAPTER II THE CASTILLIAN CORRIDOR..... | 26 |
| CHAPTER III THE RAILROAD YEARS..... | 38 |
| CHAPTER IV THE FRENCH CANAL 1880-1894..... | 49 |
| CHAPTER V THE BIG STICK..... | 55 |
| CONCLUSION | 86 |
| REFERENCES | 89 |
| CURRICULUM VITA | 97 |

INTRODUCTION

In 1955, the *Panama Canal Review*, a magazine distributed to American personnel living in the Canal Zone, committed an early act of environmental journalism. It reported that a river in the Canal's Watershed, the Río Grande, had flowed into the ground at a point in its hilly upper valley, in the narrowest point of the Great Continental Divide. Under the headline: "Zone's Historic Rio Grande Does Sudden Disappearing Act," the *Review* called attention to this unusual event. To avoid confusion with the most famous Río Grande in the American social imaginary, it notes that this stream "isn't the shallow river bordering the southern part of Texas," but the Rio Grande "explored 400 years ago by the Spanish in their search of an overland communication between Atlantic and Pacific across... Panama."¹

The Río Grande no longer exists in any form resembling its natural course. In the first decade of the twentieth century, U.S. engineers completely transformed the structure of its fluvial drainage system into what became known as the Panama Canal Watershed. The defunct river used to run from the central mountains of the isthmus toward the Pacific, taking the flow of a significant number of streams along the way. Across the Central American mountainous backbone just past the headwaters of the Río Chagres's

¹ "Zone's Historic Rio Grande Does Sudden Disappearing Act," *Panama Canal Review*, Aug. 5, 1955.

southernmost tributary began the meandering valley of the strategic Río Grande, snaking down the slope through alluvial lands south to Panama City.

The river, at a point where it was just a sluggish mountain stream and still flowed naturally, burrowed in due to its bed being filled with rock from a nearby hill.² The filling of the riverbed was “designed to stabilize the slopes of adjacent hills” and “raised the grade of the river 20 feet or more for a distance of several hundred feet.” The river reacted to an abrupt ecosystem disturbance, resulting from environmental management work connected to routine maintenance operations of the waterway. The *Review* writer ascribed agency to the river, claiming the stream had not “taken calmly to this manmade innovation” and appeared to “prefer its original bed” instead by running underground. If nothing else, this anecdotal event reveals the extent to which the operation of the Panama Canal, not just its initial construction, has entailed a continuous reworking of nature to ensure uninterrupted maritime traffic across the isthmus. It illustrates how space and environments have been historically, socially, and naturally produced.

Moreover, the piece chronicles the role played by the Río Grande in the history of Panama as a land bridge and transoceanic route. Despite his or her legitimizing tone, the unnamed, de-facto environmental beat reporter for the *Review* demonstrated some knowledge of the river’s past. “The Rio Grande of the isthmus has been tied in closely with local progress since the beginning of recorded history,” the article claimed. It then briefly traced the role of the stream within the different routes of interoceanic communication that have existed through central Panama: the Spanish mule-road, the first Transcontinental Railroad, the failed French Canal, and the American Canal. Aware

² The filling of the riverbed was “designed to stabilize the slopes of adjacent hills” and “has raised the grade of the river 20 feet or more for a distance of several hundred feet.” Ibid.

of the complications that characterized the provision of adequate sanitation and potable water during the Panama Canal's construction, the writer even makes mention of the "old Rio Grande reservoir" in the river's upper valley, "which once supplied water for the entire Pacific district between Culebra," at the continental divide, "and Panama City."³

The *Review*'s report might also hint at another important element of the Río Grande's history. Zonians, or American colonists in Panama, at least at mid-century, had a clear idea of what the nature their forefathers had allegedly conquered actually looked like. Thirty-five years after the opening of the canal when the piece was written, the Río Grande's geomorphology had been irremediably damaged. However, the Zonian writer opted to neglect the fact that, had the stream remained aboveground seeking its natural course beyond the filling, it would have had to traverse a physiography radically altered by locks, dams, diversions, and dikes. The reporter used the old name of the river and valley to denote a meager surviving stream that did not resemble the historical Río Grande. The surviving stream's unruly response to human induced environmental change does, however, highlight the basin's storied history within transnational networks of flows. This thesis uses this documented moment of sudden fluvial change reported by the *Review* as a baseline from which to reconstruct the much longer history of ecological change affecting the environmental and social spaces of this forgotten river valley.

Although a very unique case, the friction between local, transnational, and natural forces that drove change in central Panama's ecosystems resonates with other places throughout the region and the world-system's periphery, which proved easy targets for foreign capitalist and imperial schemes of resource use during the twentieth century. Most residents of Panama, a nation of just under four million, would be hard pressed to

³ Ibid.

locate the historic watershed of the Río Grande or the estuarine mangrove forest at its mouth, which existed just west of the capital. Our understanding of the origins of present-day issues and conflicts over freshwater access and availability— a political ecology issue with ties to the urbanization and expanding ecological footprint of the capital, Panama City— could benefit from a more comprehensive knowledge of the evolution of the landscapes reproducing inequalities at the edges of the Panama Canal. The construction and operation of the lock-based waterway articulates with the longer history of the Río Grande and, thus, with the history of Panama City and its hinterland, not to mention the history of the modern Republic of Panama.

This study posits the Río Grande’s trajectory as a window through which to examine central Panama’s changing environment from a glocal perspective. The Río Grande’s history has never been examined under the lens of environmental history. Framing this river valley’s changes through the prism of the region’s interoceanic corridor and water use allows a better understanding of how the isthmus’s transit tradition and the corresponding organization of human labor altered society’s relation to nature in situated and material ways. The co-evolution between Panama’s transit landscapes and society was a protracted process, one in which nature, technology, capital, and power came together to reshape the watershed, the communities therein, and Panama’s modern history.

The long and protracted process of environmental change in the Río Grande valley spans millennia; this thesis only surveys approximately the last six centuries of the defunct river’s environmental history in relation to social metabolism. With the arrival of the Spanish in the early sixteenth century, the transisthmian corridor in the isthmus’s

narrowest point was established as the ‘official’ imperial route, inserted within an early capitalist network of flows. This spatial arrangement of Panama’s population and productive activity was to persist until the twenty first century. The re-organization of the Rio Grande basin during the U.S. construction of the canal (1904 -14) stands out as one of the most significant and meaningful transformations deriving from the industrialization of interoceanic transit. This thesis will build upon secondary and primary sources, mostly engineering reports, to trace the material changes of the river and its basin in connection to the changing relationship between humans and the natural world on the isthmus. Adopting the prisms of human labor and water use can elucidate the material and cultural legacies of imperialism, and help illuminate how historical contexts altered landscapes in unequal ways over time and space.

THE ISTHMIAN RIO GRANDE: HISTORIOGRAPHY AND THEORY

Until recent decades, the historiography of the Panama Canal was infused with a ‘triumphalist’ tone dating back to the construction era. American tropes about the construction of the canal had traditionally framed the narrative as a ‘conquest over nature,’ usually revolving around the taming of the formidable Rio Chagres in the Caribbean slope or the piercing of the Culebra mountain cut. As Panamanian historian Bonifacio Pereira Jimenez stated, “The history of Panama is, to a certain extent, the history of the Rio Chagres.”⁴ Pereira Jimenez was not mistaken as to the importance that the Río Chagres had for the development of the interoceanic corridor across centuries. This focus on the Caribbean basin has hindered a more nuanced understanding of area’s historical geography, with detrimental implications for advancing Panama’s environmental history and Panama City’s urban history. However, shifting the focus to the Pacific basin sheds light on the transformation of the immediate hinterland and river systems of the country’s largest metropolitan city, and thus on the origins of the contemporary environmental problems of the metropolitan area.

The history of Panama’s transit activity, its *raison d’être*, lies at the intersection of environmental history and the history of imperialism in the region. Intellectual frameworks have been developed that enable us to understand the process by which the natural world underwent significant degradation in the modern colonial world, mainly as

⁴ Bonifacio Pereira Jimenez, *Biografía del Río Chagres* (Panama City: Imprenta Nacional, 2nd ed., 1964), 33.

a result of the onset of capitalist relations of labor, and its influence on human's views of the natural world.

In the early twentieth century, intellectuals in the neo-imperial metropolises were already starting to question the ecological impact of extractivism on the colonies and imperial spheres of influence. The French geographer Jean Brunhes developed the concept of *Raubwirtschaft*,⁵ or plunder economy, to understand the situated differential exploitation of natural resources by natives and 'civilized' groups that move in later.⁶ Years later, Carl Sauer, the father of American historical geography, also questioned how much of what we hailed as production was in reality just extraction. In 1938, Sauer, aware of the impact his country had had on the natural resources of humid tropical America, urged scholars to evaluate all colonial cultures "by the use it makes of the land it occupies."⁷

Sauer's adherents became concerned with the despoliation associated with extractive frontiers and its legacies.⁸ These scholars became the chief proponents of the "cultural landscape"⁹ as a cross-disciplinary approach to blur the problematic boundaries

⁵ Brunhes built on the concept originated by German geographer Ernst Friedrich (b. 1867), initially used to denote a type of occupation where there is no intention of developing the colony economically more than strictly needed for exploitation purposes. For a history of the concept, see Joan Martinez-Alier, *De la Economía Ecológica al Ecologismo Popular* (Barcelona: Icaria Editorial, 1994), 63 – 64.

⁶ Jean Brunhes, *La Géographie Humaine. Essai de classification positive. Principes et exemples* (Paris: Félix Alcan, 1910). For an explicit examination of this concept applied to the field of Latin American environmental history, see Guillermo Castro Herrera, "Environmental History (Made) in Latin America," *H-NET Global Historiography Series* (2001).

⁷ Carl O. Sauer, "Destructive Exploitation in Modern Colonial Expansion" (1938) in *Carl Sauer on Culture and Landscape: Readings and Commentaries*, eds. William M. Denevan and Kent Matthewson (Baton Rouge, LA: LSU press, 2009); 245.

⁸ Sauer established what became known as the "Berkley School" of geographic thought. Their work contained "dire warnings about resource depletion, species extinction, soil erosion, and overpopulation" which "signaled a renewed geographic interest in the limits of the earth to sustain human populations in the modern age."⁸ For a comprehensive expression of Berkley School themes, see *Man's Role in Changing the Face of the Earth*, ed. William L. Thomas (Chicago: University of Chicago Press, 1956).

⁹ Sauer argued that "The works of man express themselves in the cultural landscape. There may be a succession of these landscapes with a succession of the cultures. They are derived in each case from the

of the nature-culture binary. Recent scholarship of this type on Latin America's historical ecology has fruitfully questioned the "pristine myth," which posited the region as the First Eden and the kingdom of the "ecologically noble savage."¹⁰ Research on Latin America's cultural landscapes "examines various views of nature and various historical forces—" such as ideas, memories, and beliefs— "that shaped both environmental change and human-environment interactions over time," based on the assumption that the region's "different social groups at distinct times saw nature and landscape quite differently."¹¹

The conceptual framework of this thesis also fits within the approach to the study of longue duree environmental change based on ecological materialism proposed by environmental historians such as Jason Moore. This framework roots the origins of the contemporary global environmental crisis in the "transition to capitalism during the long sixteenth century (1450- 1640),"¹² a process that fed off the exploitation of commodity frontiers such as silver, sugar, or, in the case of Panama, specialized transit. Across spatial and temporal scales, this transition produced and intensified what Marx called a "metabolic rift," a "progressively deepening rupture in the nutrient cycling between the country and the city." In turn, this rift drove the need to secure new sources of cheap labor and land to sustain capital accumulation, leading to "renewed and extended cycles

natural landscape, man [sic] expressing his place in nature as a distinct agent of modification." Carl O. Sauer, "The Morphology of Landscape," (1925) in *Land and Life; a Selection from the Writings of Carl Ortwin Sauer*, ed. John Leighly (Berkeley: University of California Press, 1963); 333.

¹⁰ Mark Carey, "Latin American Environmental History: Current Trends, Interdisciplinary Insights, and Future Directions," *Environmental History* 14 (2009), 233.

¹¹ Ibid.

¹² Jason W. Moore, "Environmental Crises and the Metabolic Rift in World-Historical Perspective," *Organization & Environment* 13, no. 2 (2000), 123.

of unsustainable development on a world-scale.”¹³ Adopting the prisms of water history and global social metabolism, this thesis will contextualize the radical transformation of a particular river valley whose tragic ecological fate has been historically linked to Panama’s history and, thus, with the isthmus’ traditional transit activity and its corresponding relationship with nature and the world market.

The concept of social metabolism, a biological metaphor, proves fruitful for contextualizing the human and non-human drivers of environmental change. The use of metabolization as an explanatory analogy for collective human and network behavior offers “a powerful unifying concept to relate the functioning of society to its consequences upon the environment.” Highlighting the cultural importance of the study of energy and material flows,¹⁴ the social metabolism framework forces researchers to focus on the material and intellectual consequences of fluctuating flows of fuels, nutrients, and capital. Despite its logical home in agricultural history,¹⁵ urban environmental history also benefits from the analytical depth opened by the category of social metabolism, which enables a conceptualization of landscape and systemic processes not only in terms of human agency, but “as manifestations of biotic interactions between people and the land.”¹⁶ Revealing case studies and novel theoretical approaches

¹³ Jason W. Moore, “The Modern World-System as Environmental History? Ecology and the Rise of Capitalism,” *Theory and Society* 32, no. 3 (2003), 309.

¹⁴ Marina Fischer-Kowalski, “Society’s Metabolism: The Intellectual History of Materials Flow Analysis, Part I, 1860- 1970,” *Journal of Industrial Ecology* 2, no. 1 (1998), 61–78.

¹⁵ See for example Brett Clark and John Bellamy Foster, “Ecological Imperialism and the Global Metabolic Rift: Unequal Exchange and the Guano/Nitrates Trade,” *International Journal of Comparative Sociology* 50, no. 3-4 (2009), 311– 334; Jason W. Moore, “The End of the Road? Agricultural Revolutions in the Capitalist World-Ecology, 1450-2010,” *Journal of Agrarian Change* 10, no. 3 (2010), 389–413.

¹⁶ Metabolization as used in biological and ecological studies refers to “a summation of biological reactions,” including “the processes by which raw materials from the environment are broken down, the processes by which living cells and energy are produced as well as regulatory mechanisms.” See Alfred H. Siemens, Patricia Moreno-Casasola, and Clorinda Sarabia Bueno, “The Metabolization of Dunes and Wetlands by the City of Veracruz, Mexico,” *Journal of Latin American Geography* 5, no. 1 (2006), 7–29.

to the study of the relation between colonial extraction – of raw materials, labor or commodities – and changes in social metabolism and landscapes have been produced.¹⁷

The origins of Latin America’s environmental crises lie in the type and scale of human interventions in the ecosystems of the past. The decision-making behind many of the most significant modifications of landscape, organization of labor, and ecology in the region’s history often took place outside of the continent. As Mark Carey puts it, the “mode of production and the class structure of every place have been continually determined from outside, by their incorporation and integration into global capitalism.”¹⁸ The exploitation of the Panama’s ‘geographic resource,’ a main driver of environmental degradation, has adopted different facades and patterns of resource use over the centuries, mirroring changing geopolitical and technological paradigms. The long history of human-induced environmental change in central Pacific Panama, which has been the site of the ‘official’ interoceanic corridor for over 400 years, was marked by the interaction of transnational forces and nature. Global agents of environmental change, such as mercantilism and imperialism, came into friction with more localized ones, including capital accumulation and the provision of a food and water supply for an ever changing Panama City.

In Panamanian historiography, the main theoretical insights this paper borrows are grounded on the work of two of Panama’s most influential historians. Alfredo Castillero Calvo, who in the 1970s identified the country’s most persistent and salient *longue durée*,

¹⁷ Joan Martinez-Alier, “Marxism, Social Metabolism, and International Trade,” in Alf Hornborg, J.R. McNeill, and Joan Martinez-Alier, eds., *Rethinking Environmental History: World-System History and Global Environmental Change* (Lanham, Md.: Altamira Press, 2007), 221 – 38; Rebecca Clausen and Brett Clark, “The Metabolic Rift and Marine Ecology: An Analysis of the Ocean Crisis Within Capitalist Production,” *Organization & Environment* 18, no. 4 (2005), 422–44.

¹⁸ Carey, “Latin American Environmental History: Current Trends...,” 226.

“*transitismo*” (transit-ism), to make sense of the complicated history of human behavior on the isthmus. The concept helps elucidate the particular economic and social structures resulting from the insertion of Panama into the emerging world market, following the Spanish conquest in the early sixteenth century. Prior to the arrival of whites, indigenous groups maintained several transisthmian corridors across the territory. However, the Spanish established a monopolistic and centralized control over a single route linking both world oceans, an arrangement that has persisted to the present-day—albeit in altered forms. The formation of landscapes associated with colonial transit activity reinforced the worldview of the local oligarchy, often a market-dominant minority connected to transit activities. Besides the direct hegemony over the “geographic resource,” *transitismo* also posits the underdevelopment of other productive activity due to the overreliance on the transportation and service sectors of the economy.

Guillermo Castro Herrera has grappled with the main problems of Panama’s environmental history in an effort to provide a historical perspective to the development of a blueprint for national sustainable development. Castro Herrera applied Castillero’s concept of *transitismo* to environmental history, examining its socioecological impact over time, and tracing to it the origins of some of the most troubling problems and contradictions of Latin American¹⁹ and Panama’s environmental history.²⁰ Following Donald Worster’s study of water control in the arid American West, Castro Herrera fruitfully applied historian Karl Wittfogel’s theory of hydraulic empire to understand the authoritarianisms suffered by Panama during the last century. Wittfogel’s thesis argued

¹⁹ Guillermo Castro Herrera, “The Environmental Crisis and the Tasks of History in Latin America,” *Environment and History* 3, no. 1 (1997): 1–18.

²⁰ Guillermo Castro Herrera, “Isthmus in the World: Elements for an Environmental History of Panama.” *Global Environment* 1 (2008): 10–55.

that, in the context of ancient Chinese civilization, the Asiatic mode of production's reliance on large-scale irrigation works led to bureaucratic despotism and structural ossification and, in turn, stymied movements originating from civil society and crushed efforts at reform.²¹ Although the use of the theory of hydraulic despotism by Wittfogel and Worster was mostly concerned with irrigation in agricultural societies, the theory, as Castro Herrera shows with a case study of Panama, can be applied to any social or government structure which maintains power and control through exclusive control over access to water. Water serves as an economic mediator tying nation-states to their resource base and material spaces.

Through the prism of a strategic river valley, this study attempts to examine the relation between transitismo and environmental change over time in central Panama. Entire landscapes that had performed an important role in forging Panamanians' historic identity disappeared due to the radical physical transformation entailed by the canal.²² Although the forces of nature posed great challenges for American engineers, this aspect of the waterway's history has been simplified under the traditional triumphalist narratives explaining the canal's history. Historical geographer Omar Jaén Suárez offers a description of the environmental changes deriving from the combined impact that French and American canal building had on central Panama's ecosystems:

During almost 40 years of work in the central isthmus of Panama the most profound changes on the natural environment were produced... the derivation of the Chagres river, the creation of 423 km² Gatun lake and the smaller Miraflores lake, the construction of dams and locks, the removal of

²¹ See Karl August Wittfogel, *Oriental Despotism; a Comparative Study of Total Power* (New Haven: Yale University Press, 1957); K. A Wittfogel, *The Foundations and Stages of Chinese Economic History* (Paris:Alcan, 1935).

²² Guillermo Castro Herrera, "PRO MUNDI BENEFICIO: Elementos para una Historia Ambiental de Panamá II," in *Historia General de Panamá*, ed. Alfredo Castellero Calvo (Panama City: Comité Nacional del Centenario de la República de Panamá, 2004); 138.

hundreds of millions of cubic meters of earth and rock from the future canal channels... the landfills of Colon and Panama, the drainage of huge swamps, and the suppression of the Río Grande at the Pacific entrance of the Panama Canal.²³

If one ponders the magnitude and pace of change in the isthmus during the long nineteenth century, the pending task in Panama's environmental history remains the need to "resignify and reconstruct" these forgotten landscapes based on "chronicles, technical documents, and literary works."²⁴ This thesis aims to contribute to this need by elucidating the history of the spaces around the southern access channel of the Panama Canal. These areas of Panama's Pacific basin were completely altered and alienated from its rightful inhabitants owing to the establishment of the Canal Zone. The Río Grande valley's devastation is representative and symbolic of one of the most important environmental changes occurring within the transit region: the transformation of entire agricultural landscapes associated with Panama's urban areas into transit landscapes during the construction of the U.S. controlled waterway and territory.²⁴

The environmental history of Latin American rivers is still an emerging field. Monographs on river histories are numerous in the environmental history literature of other regions, a product of the rich window that the study of human-river relations opens into the changing relationship between society and nature.²⁵ Humans' close relationship to water, especially freshwater, has always encouraged locating settlements near reliable sources. An interdisciplinary approach to water history, including rivers, enables a

²³ Omar Jaén Suárez, *La Población del Istmo de Panamá: Estudio de Geohistoria* (Madrid: Ediciones de Cultura Hispánica, 1998); 326.

²⁴ Castro Herrera, "PRO MUNDI BENEFICIO," 138.

²⁵ For similar approaches see: Philip V. Scarpino, *Great River: An Environmental History of the Upper Mississippi, 1890-1950* (Columbia, MO: University of Missouri Press, 1985); Michael F. Logan, *The Lessening Stream : An Environmental History of the Santa Cruz River* (Tucson, AZ: University of Arizona Press, 2002); and Evan R. Ward, *Border Oasis : Water and the Political Ecology of the Colorado River Delta, 1940-1975* (Tucson, AZ: University of Arizona Press, 2003).

synthesis of its co-evolution in relation to human history, incorporating insights from fields such as cultural, economic, science and technology, social, political, and religious history as well as drawing from other disciplines. As Hernán Lasso points out, with the exception of Brazil, studies focusing on rivers as subjects of analysis have been scant in the Latin American environmental historiography. Despite its abundance of freshwater and generally well-watered territory, this type of research has not featured prominently in the field's literature, focusing more efforts at merging environmental history with other historiographical currents such as: cultural history, social history, intellectual history, and others.²⁶ A global process of accumulation characterized by the conversion of natural into financial capital accelerated after World War II, and Latin American rivers and waterscapes were subjected to modernizing pressures. Developmentalist politicians promoted public-works projects and intense dam-building. However, as the Panama Canal's case shows, there are precedents to large transformations of watersheds by transnational capital and foreign interventions.

This examination of a Central American river basin strives to enrich the current discussion about what the Canal Zone meant for the long-term structures of Panamanian society. Beyond the canal's similarities with the Suez Canal and other crucial straits throughout the world,²⁷ scholars have conceptualized the Panama Canal Zone as one of many off-limits company towns of transnational capital that flourished throughout Latin America during the late nineteenth and early twentieth centuries. Central Panama's transit region was the main, but not only, locus of the US federal government's presence on the

²⁶ Hugo Hernán Lasso Otaya, "Notes for the environmental history of Machángara River at Quito in the twentieth century," *HALAC* 2, vol. 4 (2015), 249.

²⁷ In English, a critical treatment of the Suez Canal include D.A. Farnie, *East and West of Suez: The Suez Canal in History, 1854- 1956* (Oxford: Clarendon Press, 1969).

isthmus during the twentieth century. The spaces of the Canal Zone, similar to the United Fruit Company's banana plantations or burgeoning US military base complex, were the domain of absentee capitalist and imperialist logics which dictated land-use. This thesis aims to enrich the literature on the environmental impacts of these neo-colonial ventures on the world-system's periphery, while highlighting the uniqueness of the quasi-military, quasi-civilian Panama Canal Zone among neo-colonial enclaves in Latin America. This thesis also strives to enrich Latin American environmental history's ties to activism and sustainability. This stance remains viable, and urgent, despite disciplinary criticisms of presentism, culpability, "declensionism," or accounts of progressive decline of the natural world under human activity.²⁸

In light of the impact of high population density on the quality of life in the transit region, and the near completion of the Panama Canal Expansion Project which embodies a continuation of resource use and political economic practices,²⁹ this thesis also intends to illuminate the scale of the 'urban.' Greater Panama City's modern environmental history is inextricably linked to that of the canal and its changing political ecology of water. The capital's urban growth was ultimately shaped by the territorial restrictions placed by the Canal Zone's enclosure and, later, ecological ones following the

²⁸ Eloquent articulations of this line of critique can be found in J.R. McNeill, "The Historiography of Environmental History" in *The Oxford History of Historical Writing: Volume 5: Historical Writing since 1945*, eds. Axel Schneider and Daniel Woolf (Oxford: Oxford University Press, 2011) 164.

²⁹ Panama's current environmental predicament is characterized, as Castro Herrera argues, by a contradiction between transitismo and transit. The former refers the structures determining the range of social action within which elites have historically depended on retaining a tertiary, service economy hyper-specialized toward facilitating the transit of goods, people, and capital across the isthmus. The latter refers to the modern-day practice of enabling ships to traverse the Panama Canal at the expense of social, ecological, and economic alternatives. Although this contradiction has many expressions in conflicts of political ecology throughout the country, it is clearly evident in the quandary it poses to central Panama's water management regime and sustainable development, both issues directly related to the Panama Canal and control over the waters of the modern Rio Chagres basin. This thesis aims to contribute to a better understanding of the origins of this contradictions; the water history of Panama City spatially and temporally intertwines communication, sanitation, energy, and imperial materialities.

establishment of an official, protected Canal Watershed area. A virtual straitjacket to any organic urbanization, the spatial limits to Panama City's expansion in the twentieth century determined the landscapes created by geopolitical tension and bourgeois cultural attitudes.³⁰ The following narrative tracing the Río Grande valley's history, through its connectedness with the largest city on the shoreline of Panama Bay, serves as a local case study of the planetary dynamic of agro-ecological metabolic rift proposed by Moore.

Panama's interoceanic corridor's problematic dialectic comprising glocal sustainability and the legacies of unequal relationships with world markets and global metabolism can be unpacked by its changing waterscapes, water uses, and fluvial systems. The problematic interconnectedness of the canal's and the city's day to day functioning – through the sharing of a common watershed³¹ for the distribution of water for over half of Panama's national population, as well as huge volumes of freshwater for the operation of the locks – has its origins in a convoluted process of environmental change in the early twentieth century. Therefore, this thesis attempts to employ the methodology of environmental history to further demonstrate how Panama's dependency on foreign powers and a one-dimensional productive apparatus altered social and cultural paradigms, including Panamanians' collective relationship to nature.

³⁰ The result of the combination of demographic and economic growth with political ecological limits has been urban disorder, and the resultant social chaos and environmental degradation of water sources and land are troubling. These legacies continue to condition Panama City's and the transit region's urbanization, with detrimental long-term implications for the distribution of urban water and sustainability.

³¹ Today, this water comes from lakes Gatun and Alajuela, man-made reservoirs on the Rio Chagres that provide for the hydroelectric and hydraulic demands of the canal. However, these lakes are also responsible for providing potable water to the terminal cities of the transit region, in addition to water for the generation of electricity for non-Canal related industry. The country's economy and major urban settlements depend on a common watershed management regime which resulted from the merge of the Rio Grande into the Rio Chagres.

Within the US environmental historiography, the questions at the center of this thesis are a response to Paul Sutter's grievance that "Environmental historians of the United States have been slow to move beyond the nation's borders to chart the environmental implications of the United States as a hemispheric and global actor," and that "environment has only rarely been taken seriously as one of those material dimensions shaping imperial power."³² The irreversible consequences of Latin American neo-colonialism for natural environments and resources, and the ecological footprint of military bases³³ and extractive enclaves, are increasingly seen as vital to larger transnational and inter-disciplinary debates.

Despite its historical and logistical significance to the canal, David McCullough's bestseller, *The Path Between the Seas*, only mentions the Rio Grande sparingly and fails to recognize the importance of its transformation. McCullough refers to it only as a "noisy narrow torrent winding along through dense forests below the track,"³⁴ paralleling the Panama Railroad finished in 1855. The only detailed scholarly treatment of the Rio Grande's history is included in the first chapter of Eduardo Tejeira Davis's architectural

³² Sutter's own work on the Panama Canal's construction strove to "move away from analyses of discursive and representational practices and toward the material dimensions of imperial control — to a focus on how power has been exercised on the ground." In relation to "environmental management" specifically, Sutter writes that "historians of U.S. empire have only just begun to recognize its centrality ... to the nation's extracontinental expansion." Paul S. Sutter, "Nature's Agents or Agents of Empire? Entomological Workers and Environmental Change during the Construction of the Panama Canal," *ISIS* 98 (2007); 727.

³³ The ecological impact of militarized landscapes beyond the mainland US is beginning to be studied, especially in literary works that embrace themes of environmental justice. However, the impact on waterscapes and urban growth are seldom explored; see Hsuan Hsu, "Representing Environmental Risk in the Landscapes of US Militarization," *Environment and Society Portal* (Virtual Exhibitions no. 1, 2014) <environmentandsociety.org>.

³⁴ David McCullough, *The Path Between the Seas: The Creation of the Panama Canal, 1870 – 1914* (Simon & Schuster, 1977), 113.

and planning history of Ciudad del Saber (City of Knowledge),³⁵ a research and development complex established in a reverted and repurposed U.S. military based built in 1919 on a riverbank of the Rio Grande. Tejeira Davis notes that the only geographical feature that remains intact in the area is the Rio Cardenas, a tributary of the Rio Grande that joined the basin's main river north of Panama City.³⁶ This thesis will build upon Tejeira Davis's work to provide a more comprehensive environmental perspective of the river's history, drawing from diverse fields such as Latin American, U.S., and science and technology historiographies.

Panama Canal connected river ecosystems that had been separated for evolutionary eras. Understanding the spread of species spatially along the Panama Canal, for instance, requires a diachronic picture of the area prior to its construction. The reorganization of the environment generated a species mix that is hard to gauge without a historical perspective.³⁷ The immediate environmental consequences of uniting the world's oceans through the linking of isthmian rivers have fascinated scientists for decades.³⁸ A recent study of invasive species in the Panama Canal Watershed compared

³⁵ Eduardo Tejeira Davis, *Ciudad del Saber: Un Legado en Construcción* (Panama: Editorial Ciudad del Saber, 2010).

³⁶ *Ibid.*, 14 – 15.

³⁷ See Pamela Henson's piece, "A Baseline Environmental Survey: The 1910–12 Smithsonian Biological Survey of the Panama Canal Zone," in Ashley Carse, Christine Keiner, Pamela M. Henson, Marixa Lasso, Paul S. Sutter, Megan Raby, and Blake Scott, "Panama Canal Forum: From the Conquest of Nature to the Construction of New Ecologies," *Environmental History* 21 (2016), 206–287.

³⁸ The term 'immediate' aims to differentiate the consequences for local ecosystems from those affecting regional or global ecosystems, which are harder to ascribe to the opening of the strait. For an early example of this line of research dealing specifically with fish, see S. E. Meek and S. F. Hildebrand, "The fishes of the fresh waters of Panama," *Zoological Series* 10, n. 15 (Field Museum of Natural History, 1909), 217–374.

the species make-up of the two distinct river basins that were welded together into one in the early twentieth century: the *Río Chagres* and the *Río Grande*.³⁹

Although some of the towns named after its tributaries survive, and the headwaters of some of its feeders remain alive, the river has diluted from collective memory. Nonetheless, the latest stage in the history of the interoceanic corridor across central Panama has endured to our days, and its materiality has had the greatest environmental impact upon the *Río Grande*. Therefore, this narrative will favor the early twentieth century because the rate of morphological and social change in the region accelerated dramatically during this period, just after the end of the Thousand Days' War in 1902, and left an important imprint on the transit landscapes and waterscapes of the twenty-first century.

³⁹ S.A. Smith et al., "Cross-Cordillera exchange mediated by the Panama Canal increased the species richness of local freshwater fish assemblages," *Proceedings of the Royal Society of London Biol Sci* 271 (2004) 1889 - 1896.

NATURAL HISTORY AND PRE-COLUMBIAN CORRIDOR

From jutting peninsulas to island continents, our planet boasts some unique land formations. Among these workings of the earth's inner layers, the isthmus of Panama is unique. The area of southern Central America is subject to the interaction of five different tectonic plates, with three of these meeting at two separate junctures, accounting for a volatile and complex geologic zone. After the breakup of Pangea, the landmasses of North America and South America were isolated from each other. These spatial differences are crucial to understanding why human schemes to link both the Atlantic and Pacific have historically concentrated in central Panama and, more importantly, how nature has shaped these interoceanic ventures. "The geographical position of Panama and its diverse historical circumstances," as Carlos Malgrat asserted, "constitutes the principal cause of the existence of diverse groups of humans on the isthmus."⁴⁰

About 65 million years ago, between the two Americas lay a series of islands of volcanic origin which would later be called Costa Rica and western Panama. Gradually, a sill⁴¹ one thousand meters underwater formed between the two oceans. This deposit of volcanic material already contained the bedrock of what would comprise the future transit region.⁴² Caused at least in part by a growth spurt in the Antarctic ice sheet decreasing

⁴⁰ Carlos Malgrat, "Contribución al estudio de la personalidad básica del panameño," in *Panamá en sus usos y costumbres*, ed. Stanley Heckadon Moreno (Panama City: Editorial Universitaria), 389.

⁴¹ In Geology, a sill is an underwater ridge or rock ledge extending across the bed of a body of water.

⁴² Anthony Coates, *Central America: A Natural and Cultural History* (New Haven: Yale University Press, 1999), 16-21.

sea levels, the sill became an archipelago due to the uplift of the isthmus and differences in elevation across its extension. The land barrier between the oceans completely rose above water between three and six million years ago. During recent geologic time, the Pacific coastal waters were fifty meters below current levels; an important portion of today's Panama Bay was coastal plain featuring hills whose peaks constitute today's offshore islands.

The formation of the isthmus altered the very dynamics of the earth. Rather than a sudden emergence, this was a protracted process that produced the unique geological mix of terrains in the center of the isthmus. The formation of the barrier between the oceans isolated two distinct coastal ecosystems. This allowed for separate and distinct natural histories to develop, resulting in different coastal geographies along both shorelines. The isthmus obstructed an ancient current of water, known as the Tropical American Seaway, and diverted it northward, creating the Gulf Stream. The trade winds, which blow from northeast to southwest through Panama, faced a new obstacle that forced them to blow between new mountain passes, resulting in a patchwork of drought-prone regions in the Pacific basin.

Eons before it became a crossroads between human realms, the isthmus formed “a land bridge over which inhabitants of each America invaded each other —the so-called Great American Biotic Interchange.”⁴³ These invasions transformed the terrestrial flora and fauna of two continental ecosystems. The natural nexus provided the structural opportunities for mobile species eager to colonize higher or lower latitudes. The forests of southern Central America evolved, from resembling those of the present day Southern

⁴³ Egbert G. Leigh and Aaron O’Dea, “Historical biogeography of the Isthmus of Panama,” *Biological Reviews* 89 (2014), 148.

United States, to looking more like their South American counterparts. This interchange also altered plant and animal assemblages of the land bridge that enabled it, creating the base for the eclectic biodiversity that survives today. In 2005, a study estimated that sixty percent of tree species in central Panama (433 species!) traced their origins to cross-Andean or Amazon basin ecosystems.⁴⁴ Endemic animals, mostly grazers like giant and regular sloths but also forest dwellers like raccoons, took advantage of the isthmus' "mosaic of plant communities" to reach South and North America, while altering the land bridge's landscape on their way. The records of migrations and pollen recordings point towards a persistent, evolving evergreen forest cover – albeit with stretches of grassland – that acted as a "filter for species," accounting for its rich biodiversity.⁴⁵

Accidents of geology and the fluctuations of the climate system endowed Panama with unequalled natural attributes favoring human settlement. Wind and ocean circulation dynamics create hurricanes that scourge the belt running from Costa Rica to Yucatan with brutal regularity.⁴⁶ The climate system interaction with the earth's rotation produces a particularity in this area known as the Coriolis Effect,⁴⁷ causing hurricanes to deviate just north of modern Panama in the Intertropical Convergence Zone. Much of Panama is thus protected from infamous Caribbean hurricanes.

A volcanic arc that originates in Mexico ends in El Valle, located close to the center of the modern republic of Panama, but far enough from what would become the

⁴⁴ Christopher W. Dick, "Long-distance gene flow and cross-Andean dispersal of lowland rainforest bees," *Molecular Ecology* 13 (2004), 3775-85.

⁴⁵ Coates, 127-136.

⁴⁶ Ibid., 23-27.

⁴⁷ Encyclopedia Britannica. < http://abyss.uoregon.edu/~js/glossary/coriolis_effect.html >

transit area. These same “buckling forces” account for the earthquake belt running from western Panama into Mexico, again sparing the eastern half of today’s Panama.⁴⁸

The nature of Panama’s coastal landforms, comprising an elevated percentage in this Central American case, illustrate the traditional geomorphologies of fluvial lowlands. Coastal plain river valleys commonly include meandering rivers with relatively broad floodplains. Rivers are important components of coastal plain settings, as Paul Hudson explains, “their alignment and orientation playing a determinant role in the structure and form of a 'subtle' landscape.”⁴⁹ Due to the nature of the physical structure of Central America’s isthmus and the ecosystems of the narrowest area with close, transoceanic basins, the rivers of Panama are uniquely important for the region’s physical and human geographies.

The isthmus’s rivers tend to snake down its slopes carrying thick, chocolate waters and ending in big, littoral swamps. Their waters dye the Pacific and Caribbean coasts with their yellow, sepia, pink and muddy green color.⁵⁰ The Caribbean slope, due to the proximity of the cordillera, is generally drained by shorter and more torrential rivers than the Pacific basin. The Pacific slope’s coastal plain, comprised of fertile but easily eroded soils, is drained by more linear rivers that fluctuate dramatically with the uncertain precipitation patterns that plague the area’s monsoon-based climate.

In East-Central Panama, henceforth called the transit region, both oceans are separated by less than 100 kilometers of land that, for the most part, does not exceed 25 meters above sea level. However, the Caribbean and Pacific coastal and inland

⁴⁸ Coates, 13-19.

⁴⁹ Paul F. Hudson, “Floodplain Styles of the Lower Pánuco Basin, Mexico.” *Journal of Latin American Geography* 1, no. 1 (2002), 58.

⁵⁰ Jaen Suarez, *Poblacion del Istmo de Panama*, 316.

ecosystems are significantly different. Both slopes boasted portions of mangrove and different types of coral reefs. The belt that comprises the transit region was mostly covered by tropical rainforest, except for a narrow stretch of grassland along the Pacific coast. In this area, the cordillera dwindles down to an assemblage of short hills before regaining mountainous height towards Darien. This series of hillslopes and intervening valleys comprise the basin of the Río Chagres and the relatively meager Rio Grande. Historian of the construction period of the Panama Railroad, Joseph Scott, claims that: “The configuration of these *almost-connecting* river valleys had made them a trade route across the isthmus since the earliest times.”⁵¹

Human groups constituted an isthmian civilization long before the conquest of the early Spanish Main, the process by which these peoples were incorporated into Iberian mainland coastal possessions surrounding the Caribbean Sea and the Gulf of Mexico. These groups had distinct adaptations to their tropical environments and understanding these features can enable a partial reconstruction of their settlements in the Rio Grande basin. It is important to note that groups on both sides of the drainage divide traded products that were unique to their ecosystems⁵²; thus, interoceanic communication was a lived experience of early isthmian civilization. The Río Chagres on the Caribbean and the Pacific Rio Grande probably served as cogs of a transisthmian route, located on that “narrow strip of land which has long served as the primary passage between the

⁵¹ My emphasis. Joseph L. Scott, *Rails Across Panama; the story of the building of the Panama Railroad, 1849-1855* (Indianapolis: Bobbs-Merrill Company, 1967); 4.

⁵² The space occupied by the Panama Canal today, as stated before, was used by indigenous groups as areas of inter-ecosystem exchange and, in the first decades of the sixteenth century, was identified by the newly arrived Spanish as the best crossing between oceans.

oceans.”⁵³ However, there were several other routes coexisting with the Chagres route across the isthmian region.⁵⁴

Due to general human preferences, the drier Pacific slope was more densely populated than the wetter Caribbean. In central Panama, the continental divide is close to the southern shore of the isthmus, and the slope is thus “very steep and whatever water falls runs away almost immediately.”⁵⁵ For at least 2000 years before the Conquest, since the late Neolithic period, densely populated settlements in the Pacific basin were found mostly on alluvial plains. The units of organization, *Cacicazgos*, were organized around the area’s rivers which generally run from North to South, and these territories generally paralleled their vertical orientations.⁵⁶ The use of fire in agriculture and hunting was commonplace, and the anthropic savannas of the Pacific basin attest to this fact.⁵⁷

⁵³ Stanley Heckadon Moreno, “Impact of Development on the Panama Canal Environment,” *Journal of Interamerican Studies and World Affairs* 35, n. 3 (1993), 132.

⁵⁴ Guillermo Castro Herrera, “Panama, un Territorio en Tres Tiempos,” *HALAC* 3, n. 1 (2014), 145 – 146.

⁵⁵ Charles Marsh, “Report on fresh-water copepoda from Panama, with descriptions of new species,” *Smithsonian Misc. Collections* 61 (Washington, D.C.: Smithsonian Institution, 1913).

⁵⁶ *Ibid.*, 147.

⁵⁷ In fact, few patches of old growth forest remain in the transit region. Most of the present-day Canal Watershed’s protective forests are new growth dating to the colonial period.

THE CASTILLIAN CORRIDOR

During the early stages of the conquest, the Spaniards were looking for an interoceanic passage through the Spanish Main. The establishment of Panama City, the first European-founded settlement on the Pacific, was determined by the immediate imperatives and logic of securing a colonial outpost. The site was chosen because it could function as the southern node within a strategic axis of settlements that provided the orientation for the initial territorial organization of the isthmus. A surrounding miasmatic environment, being flanked by mangroves and swamps on both sides, compounded the lack of nearby sources of potable water. Being by necessity established in Panama Bay, the sites of Old Panama and its successor⁵⁸ did boast harbors that were usable. Following a fire which consumed the original settlement during the invasion and sacking by Welsh pirate Henry Morgan, Panamá was moved a few miles westward, closer to the mouth of the Rio Grande.

The colonial core of the city was relocated in the *Ancón* area, the vicinity of the 200 meter elevation overlooking the city that dominated the landscape of the lower Rio Grande. Castellero Calvo notes that the site was called ‘Ancón’ because of the existence

⁵⁸ In 1671, Panama City was destroyed by a fire following an assault by privateer Henry Morgan. In 1673, the city was re-established in a peninsula located 8 kilometers to the west, toward the mouth of the Rio Grande.

of two ‘*ancones*’ or, following the Castillian term, two anchorable harbors.⁵⁹ One of these was the mouth of the Rio Grande.

The historic Rio Grande basin, covering approximately 85 square miles, could host about three hundred homesteads. Traditionally, the fluvial lowlands were inhabited by peoples working annual swiddens of maize, sugar mills, and stock of cattle and pigs. Their surplus was carried downriver aboard canoes to be sold in Panama City.⁶⁰ During the rainy season, the streams of the Pacific basin frequently interrupted land travel across the savannahs along Panama’s Pacific coast. In the dry season, their stream-like trickle rendered them generally unnavigable. Despite great seasonal variability, the river was embedded within a production and distribution system of local food, and its role was heightened due to the general geography of the Pacific basin and the regional concentration of the isthmus’s population ultimately controlled by the Crown.

The earliest description of the river remains that of Diego Ruiz de Campo, a seventeenth century explorer who described the hinterland of Panama City as follows:

“A fourth of a *legua* from the Cerro Ancon towards the west there is an inlet that has beaches on both banks and has as a whole a third of a *legua* in width, said inlet is completely open to the south and in its middle drains that mouth of the rio Grande that takes the whole length, and at the entrance of said river lies a flat islet full of mangroves without there being any tree of benefit and said islet is swampy which makes the river have two channels in its mouth and the one on the right is more anchorable and [boats] can enter and boats go up with the tide to carry lime, honey, maize, plantains and other things that lie upriver which is covered by tall mangroves on both flanks that are of no benefit for anything [...]”⁶¹

⁵⁹ As quoted in Tejeira Davis, “El Casco Antiguo de Panama.”

⁶⁰ Jean-Pierre Tardieu, *Cimarrones de Panamá: la forja de una identidad afroamericana en el siglo XVI* (Madrid: Editorial Iberoamericana, 2009), 205.

⁶¹ Diego Ruiz de Campos, *Relación sobre la costa panamena en el Mar del Sur*, quoted in Omar Jaen Suarez, *Geografía de Panamá*, p.53

Directly off the coast from the mouth of the Rio Grande lie four islands, the main ones being Naos, Flamenco, and Perico. Due to Panama Bay's wide tidal range, the islands served as early harbors since the early sixteenth century. In 1591, Spanish engineers Juan de Tejada and Juan B. Antonelli proposed moving the city to the bank of the Rio Grande, owing mainly to its "handsome savannah" environments and its location just a half *legua* away from the port at Perico.⁶² The Spanish military engineer, Nicolás Rodríguez, produced a map in 1735 that traced the two transisthmian routes sponsored by the Crown, the Cruces and Gorgona trails, with detailed hydrologic features.⁶³ The map shows a labeled Rio Grande, the names of its tributaries Rio Cárdenas and Caimitillo, and the topography surrounding the paths.

The traditional narrative about the selection of the site of what would become Panama City includes mention of the area's scant water resources. The water portfolio was poor, and depended on riverine and underground sources to even meet the populations' needs.⁶⁴ Nearby streams served as workplaces for washerwomen and for individuals dedicated to gathering water and selling it in towns. The natural environment in the area did not have hydrological features benefitting urban dense settlement, but the imperatives of empire-building and exploration made the location permanent.

With the arrival of the Spanish and the decimation of native nations, *transitismo* emerged as the specific way of insertion of the isthmus into sixteenth century transnational networks and as the dominant paradigm of economic mercantilism on the

⁶² Jean-Pierre Tardieu, *Cimarrones de Panamá*, 205.

⁶³ Archivo General de Indias, Sevilla, sign. MP Panamá 137, reproduced in Tejeira Davis, *Ciudad del Saber: Un Legado en Construcción*, 13.

⁶⁴ Today, this narrative is reinforced by the current hydrologic landscape of the capital's metropolitan area, which features severely degraded urban streams and nearby rivers suffering from pollution and the uncertainties of climate change.

ground. Transitismo established a central axis of organization with an East to West direction, colonizing a savannah interior with cattle ranches in order to maintain the flow of bullion and biomass across the transit region. Through the majority of the colonial era, Panama functioned as a land bridge where merchants congregated at its termini from pain and America to barter and peddle their goods. This was a vital part of the Spanish imperial fleet and fair system, and dominated the colony's rent-producing activities.

The society that took root in what today is known as Panama was controlled by elements of a mercantile-oriented oligarchy. These sectors quickly accumulated some wealth deriving from their relationship with imperial transisthmian traffic. They dominated the tertiary apparatus articulated to Spain's monopolistic control of the transisthmian route including ownership of storehouses for Incan silver, following Francisco Pizarro's conquest, and other transit-related activities, such as the importation and reexportation of African slaves to other Spanish possessions in the Pacific. Around the middle of the sixteenth century, the incorporation of Peru into new mercantile networks brought about the articulation of the savannah hinterland of Panama City to the transit economy.⁶⁵ This connection was brought forth as a spatial byproduct of decision-making over land-use by a mercantile and landowning elite, the ruling class of the isthmus's socio-economic formation based on slavery and dependent on livestock, a land gobbling economic enterprise, onto the tropical lowlands of the Pacific coast.⁶⁶

The demographic and political transition that the isthmus underwent during the sixteenth century left its mark in the Rio Grande valley. There are records of at least one

⁶⁵ Guillermo Castro Herrera, *El Agua Entre Los Mares*, 119.

⁶⁶ Karl Butzer notes that livestock as a main economic activity was an experimental venture and adaptation to America: "cattle raising was small-scale and of subordinate importance in Spain, except in the estuarine marshland below Seville." Karl W. Butzer, "Cattle and Sheep from Old to New Spain: Historical Antecedents," *Annals of the Association of American Geographers* 78, no. 1 (1988), 29.

reduccion, an artificial indian settlement established by the Spanish to control and exploit a previously scattered native labor force, being founded along its tributaries in 1581.

These settlements were somewhat different in Panama due to the high and precocious number of African slaves, which were ‘reduced’ alongside surviving natives. Central America was one of the areas of the New World worst hit by the decimation of indigenous populations, with estimates positing a 90% mortality in the isthmus.

The human and physical geographies of the isthmus posed challenges for the integration of Panama City with its hinterland. The seasonal streams carved in the Pacific obstructed East-West travel, hindering transportation of people and goods into the city.⁶⁷ The establishment of Spanish villas, especially those at the termini of the transisthmian corridor, enabled the conquest of vast areas for cattle grazing. However, large areas remained as frontiers due to hostile indigenous settlements and impenetrable forests (such as the mighty Darien to the East and Bocas del Toro, famous for its more recent history as a banana and later eco-tourism locale). Despite the prodigious availability of cattle and the fact that dried beef, cattle lard, and skins was exported during the colonial era, the Panamanian diet suffered shortages that exacerbated whenever rumors of pirate attacks swirled.⁶⁸ Flat field agriculture and plowing methods did not thrive in the isthmus, and Panama became the only Latin American country where rice was as common as maize. The few plantations established on the isthmus produced sugar cane and cotton, but most cultivated land was worked by small producers of coffee, mangoes, cacao, plantains, and

⁶⁷ Omar Jaen Suarez, *La Poblacion del Istmo de Panama*, 136.

⁶⁸ Alfredo Castillero Calvo, 428

bananas. By the late colonial period, pasture occupied more land than crops, supporting close to 193 000 heads of cattle, but still 93% of the land was forested.⁶⁹

The colonial interoceanic route was usually a combination of overland and fluvial segments, and the corridor could not be traversed in fewer than four days, or more depending on weather conditions. The most important route depended on mules brought from stables in Central America and African slaves that drove the mule trains. Loaded with silver, these mules required large quantities of maize to work. The functioning of this early isthmian route, that in the Pacific slope ran parallel to the Rio Grande, enabled Europe to develop the so-called original accumulation, as the huge flow of precious metals from South America to Spain via Panama played a critical role in the monetization necessary to create a modern market economy. The exploitation of Panama's geographic resource during the initial period of an interoceanic corridor connected to the emerging world system depended wholly on human and animal energy: African muleteers and *bogas* provided transportation services by providing smooth interoceanic passages for both local and foreign masters.

Transisthmian transit was extremely dependent on local conditions, from microclimates in both basins to the ability to control a labor force. The subjugation of Indians and African slaves was essential for the urban elite to profit from the transit enterprise. The isthmus' rivers and their valleys were central in this corridor. Producing food to feed transit workers and pack mules was also a need that had to be addressed locally. The mercantile-oriented oligarchs turned strongly to cattle raising in the anthropic savannahs of the capital's hinterland, establishing the defining characteristic of Panamanian food systems. Pedro Arias Davila, the first governor of Panama City,

⁶⁹ Hall, *Historical Atlas of Central America*, 156.

introduced 50 heads of cattle from his *hacienda* in Jamaica, providing the stock for future cattle economies from Nicaragua to Peru. As Castro Herrera puts it, “this was largely possible because cattle found an exceptionally favorable niche in the savannahs that the aboriginal population had created over the previous 2,000 years, mainly in the central and western plains of the Pacific basin of the Isthmus.”⁷⁰

The animal protein that was raised in the countryside served to feed transit workers whose labor was coerced for imperial transportation rather than agricultural or other extractivist production. Besides its intrinsic relationship to the Spanish treasure fleet through its sustaining foodstuffs, cattle raising presented clear benefits as a supporting economic activity in this colonial outpost on the edge of European civilization: the colonizing of ecosystems through conversion of land to pasture, exclusive resource use through land titling reinforced the privilege of whiteness in Spanish Panama, the superabundance of cattle afforded a degree of food security in the transit region, cattle corpses produced important market products including tallow and fiber-like products, and livestock functioned as a mobile bank account in drought-prone central Pacific Panama.

The grasslands of the Pacific slope’s coastal plain were a combination of natural and anthropic savannahs. The most common grasses included a stable assemblage of drought-tolerating species which, until the middle of the nineteenth century, included: broad stalkgrass (e.g. *Pharos latifolius*), *Arundinella deppeana*, and *Trasya sp.* The most important weed of the savannah was *Mimosa pudica*. Historically, the savannahs of the Pacific basin were not continuous, but were interrupted by gallery forests flanking the

⁷⁰ Guillermo Castro Herrera, "Isthmus in the World: Elements for an Environmental History of Panama." *Global Environment* 1 (2008): 20- 21.

streams.⁷¹ This mosaic of environments, a vast brushland *savannah* laced with riparian woodlands, persisted especially up to the nineteenth century. The area between the last coastal plains and mouth of the Rio Grande and Old Panama was under pasture since before the destruction of Old Panama.

Boom and bust cycles of economic bonanza defined Panama's economy and the metabolism of available natural and human resources. The geographic resource became fetishized under the ideology of *transitismo*, and its logic guided official land-use patterns far beyond the transit region during the colonial era. Despite fluctuations in transit activity throughout the colonial period, population never rose above 1500 inhabitants dependent on agriculture and the transport of passenger and cargo, by mule and small boat, across the isthmus.⁷² The cattle-based economies of the rest of the Pacific slope, extending into the lowlands of the Azuero Peninsula and further even to modern-day Chiriqui province, had particular ecological effects on their native landscapes. The problems of deforestation, land monopolies, soil depletion, and erosion associated with the cattle centered agrarian activity in Panama need to be understood in relation to *transitismo*'s demand for resources far beyond the transit region.

The transit landscapes associated with the early imperial routes, the so-called Cruces and Gorgona trails, were the result of a strictly controlled route handling low intensity commodity flows. The "preindustrial transit," flowing from 1550 to 1850, was financed by domestic capital and fueled by slave or peon labor. The technology enabling the first capitalist iteration of the transoceanic corridor --- stone trails, mules, feed, and

⁷¹ Ibid., 140

⁷² Stanley Heckadon, "Impact of Development on the Panama Canal Environment," 132.

small settlements at river crossings --- was “adapted to the restrictions of the environment” and this arrangement persisted beyond independence of 1821.⁷³

In 1827, John A. Lloyd, Simon Bolivar’s envoy to Panama to determine the best route for a road or a canal, described the Rio Grande as “emerging close to a hill called Pedro Miguel, and becoming navigable for large canoes as it receives several creeks.”⁷⁴ Lloyd also calls attention to the sandbank blocking the mouth of the river, two miles west of Panama City, attributing this feature to the low tide of the Bay dropping below two feet at the entrance.

The decision-making pertaining to interoceanic transit across the isthmus of Panama was mostly located outside of the isthmus. However, human agency was exerted on the ground – albeit unequally – following colonial and republican Latin America’s patterns of governance. At this point it would be helpful to understand the worldview of Panamanian elites who have collaborated in establishing and perpetuating transitismo since the sixteenth century and, thus, have shaped the range of relations possible between humans and the Rio Grande basin.

The evident incapacity of the New Granada’s establishment to adequately manage the transisthmian transit in the conditions of world trade emerging in the mid-nineteenth century fed the isthmus’ elites reasons to envision a different relation to the world market. Mariano Arosemena, one of Panama’s leading intellectuals during the first half of the nineteenth century, argued that if Panama was to exploit its maritime potential it needed more contact with North Atlantic societies and more freedom from the influence

⁷³ Castro Herrera, *El Agua Entre Los Mares*, 147.

⁷⁴ As quoted in Eduardo Tejeira Davis, *Ciudad del Saber: Un Legado en Construcción*, 14.

of conservative Bogota.⁷⁵ Panama's majority black population, which was becoming increasingly organized and incorporated into republican life, added to elite concerns about sustained prosperity. Although Panama never developed an intensive export-oriented plantation economy, the transit economy and the transit region's role in Spanish America perpetuated a population dominated by slaves and free people of color. In part as a strategy for legitimizing their power and to avert an uprising evoking Haiti's revolution, Arosemena explains that "We [elites] occupied ourselves with proposing laws... that were necessary for the growth of intermaritime traffic."⁷⁶

Panama's white ruling class formulated a new blueprint for the future: a "Hanseatic project." In the mid-nineteenth century, the term *comunicación*, or communication, was a term used regularly by Panamanian thinkers to denote the "circulation of goods, people, and information from one point of the planet to another." For these writers, the concept of sovereignty, or "*soberanía*," was primarily concerned with "the organization and enactment of power over territory and flows of people, information and goods through governmental and extra-governmental means."⁷⁷ The oligarchy espoused an ideology that did not leave room for the development of productive forces not directly related to their concept of communication as production.

Their vision entailed perpetual dependence on international transit and close interaction with white foreigners. The internationalizing bent of this precursor of the modern globalization ideal was to transform Panama into an "emporium of universal

⁷⁵ Peter Szock, *La Ultima Gaviota: Liberalism and Nostalgia in Twentieth Century Panama* (Praeger, 2001), 22.

⁷⁶ Ibid.

⁷⁷ Aims McGuiness, *Path of Empire: Panama and the California Gold Rush* (Ithaca: Cornell University Press, 2008) 9.

commerce.⁷⁸ The so-called *anseatista* movement proposed that Panama, like the Hanseatic ports of Baltic maritime trade, should enjoy special status as a free-trade zone: managing its own affairs but protected by one or more major maritime powers. Despite conflicting cultures of nature co-existing in the Panamanian territory, urban and transit-dependent elites consolidated control upon the larger society's relationship to the interoceanic environment. Arosemena, for example, envisioned the anticipated entry of the interoceanic corridor into the industrial age.⁷⁹ In 1824, the writer and businessman specified the ideal conditions of the exploitation of the isthmus' geographic resource, demanding it materialized as a fluvial route, as opposed to rumors about possible railways, traversing the historic transit region and uniting the Río Chagres and Río Grande.⁸⁰

Nonetheless, the rising political ambitions of creole lawmakers did not have a significant impact on des-accelerating transoceanic flows, which had been in decline since the early eighteenth century. The duration of the transit across the isthmus continued to be highly contingent, dependent on the availability of transport, weather conditions, and other factors. Historian Aims McGuinness provides a snapshot of the late days of the ancient route:

“[The corridor] was controlled and operated by a distinct group of workers, many of whom were also proprietors of the means of transport, including mules and dugout canoes known as *bongos*. The waters in the harbors at Chagres [Caribbean port] and Panama City were too shallow to permit oceangoing ships to draw close to shore, and so arriving ships were forced to anchor as far as a

⁷⁸ Szock, *La Ultima Gaviota*, 21.

⁷⁹ Celestino Andrés Araúz, “Un Sueño de Siglos: El Canal de Panamá,” *Revista Tareas* 123 (2006), no pagination.

⁸⁰ According to Araúz, Arosemena laid out his vision to counter that proposed by general Juan D. Everaux. Arosemena thought Everaux's project too costly and detrimental to native mercantile activity in the isthmus, due to its elimination of ports in the traditional terminal cities of the interoceanic corridor. *Ibid.*.

mile off the coast. Local boatmen provided transportation from ship to ship using bongos or small sailboats. People arriving at the port of Chagres continued up the Chagres River in bongos to the town of Gatun or, if waters permitted, to the town of Cruces. Passengers either walked the rest of the way or, more commonly, negotiated with still other local men for transportation by mule. Travelers also had the option of hiring porters, or ‘*cargadores*,’ who carried cargo and sometimes passengers on their backs using harnesses.”⁸¹

The demands of the local oligarchy for a return to the days of the isthmus serving as an imperial route were ultimately fruitful. While Simon Bolivar could not realize his dream of Panama becoming the articulating joint of a united continent, during the second-half of the nineteenth century, the growing power of transnational capital would reassert its will upon landscapes of the neo-tropics. The changing material culture of western society brought about an unavoidable juncture of change for the Colombian state of Panama.

⁸¹ Aims McGuiness, *Path of Empire: Panama and the California Gold Rush* (Ithaca: Cornell University press, 2008), 33 – 34.

THE RAILROAD YEARS

Starting in the late eighteenth century, an expanding world market created the conditions for the mechanization of production, transportation, and communication in the Old World. The harnessing of novel energy sources increased the calculus of profitability for the capitalist classes in North Atlantic countries. Stephen Bunker claims that “it was not until the nineteenth century that the technologies developed and the capital accumulated in industrial production fed back into the rapid advances in fossil fuel-driven transport, in steel constructed vessels, and frames on steel constructed infrastructure.”⁸² This explosion in production generated the conditions for a new wave of capital accumulation and population growth, which defined the era of industrial capitalism as much as did the mechanization of production. New technologies ushered in new relations of production and resource use. Moreover, the new system also signaled a paradigm shift in human relations with nature, altering traditional, culture and place-specific balances. Industrial capitalism depended on a worldview that reduced non-human nature to its productive moment, treating it as a reservoir of commodities.⁸³

Operating within this conception of nature, Adam Smith asserted that the wealth of a nation lies in its ability to produce. David Ricardo extolled the virtues of local specialization to engage in competitive, global markets. However, it is doubtful whether

⁸² Stephen G. Bunker, “Natural Values and the Physical Inevitability of Uneven Development under Capitalism,” in Alf Hornborg, J.R. McNeill, Joan Martinez-Alier, ed., *Rethinking Environmental History: World-System History and Global Environmental Change* (Lanham MD: AltaMira Press, 2007), 239.

⁸³ Guillermo Castro Herrera, “PRO MUNDI BENEFICIO,” 135.

they had in mind the type of specialization and production that would be established and perpetuated in Panama during the nineteenth century. The area's one-dimensional economy and dependence on transit was maintained by blatantly oppressive structures of power such as slavery and socially constructed food scarcity. New transportation techniques and navigation routes stimulated maritime traffic that bypassed the isthmus. Panama's elites were unable to maintain the logistical relevance of the transit region and navigate the grander changes.

A transnational transformation in the material conditions of transportation in general would eventually lead to a reevaluation of the isthmus in a changing context. Prior to the emergence of modern transportation technologies, following Immanuel Wallerstein, "long-distance transfers were generally restricted to preciosities (high value, low bulk commodities)," such as silver, spices, and ivory. The extraction of these commodities had significant negative ecological consequences in the colonies, but their consumption only had a "slight significance for the metabolism of the core." The mid-nineteenth century saw the "long-distance exchange of bulk commodities... become crucial to the metabolism of some importing countries in Europe."⁸⁴ The growing interconnection between states not only allowed raw materials and commodities to flow, but also "increased the mass of matter and energy transformed by industry," while at the same time intensifying the world-system's "inherent tendencies to spatial concentration."⁸⁵

In this context of unequal and combined development, the consolidation of the periphery-status of many of the world's regions, such as Latin America where liberal

⁸⁴ Joan Martinez-Alier, "Marxism, Social Metabolism, and International Trade," in Hornborg et al., ed., *Rethinking Environmental History*, 232.

⁸⁵ Bunker, *Ibid.*, 241.

republicanism stood as a shoddy façade, defined the direction of flows of this new world system. New technologies ushered in a new stage in human-nature relations in European societies and their diasporas throughout the world. New mechanistic attitudes toward nature coincided with imperialistic social attitudes held by decision-making elites. These patterns of imperial behavior had grave implications for the political ecology of the isthmus due to its close proximity to a burgeoning U.S. “Panama would no longer be the isthmus of Seville, Cadiz, or even Jamaica,” Jaen Suarez explains, “The North Atlantic powers would rapidly succeed them. Panama would become the isthmus of New York.”⁸⁶

Throughout the nineteenth century, the U.S. continued to march west following its imperial banner of *Manifest Destiny*, continuing a federally-led, violent spatial expansion and territorial dispossession of indigenous lands. This westward migration can be understood as a micro-globalization in its own right, a safety-valve to deflate mounting regional tensions over slavery and ensure uninterrupted profits to its capitalist class. The imposition of the U.S. dollar as a universal, gold-backed currency over the vast territory was only accomplished due to the growth of the central government during this period.

The discovery of gold in California in 1848 created a pull factor for get-rich quick oriented masses of different origins. Multiple paths across Central America started to figure in the American imaginary as routes to reach the west coast of the U.S. Panama was chosen over a Nicaragua to provide a railroad link for maritime passengers. A tortuous overland route across the American Great Plains and West highlighted the Panama option as a safer, more convenient way to shorten the trek. The availability of

⁸⁶ Omar Jaen Suarez, *Poblacion del Istmo de Panama*, 274.

steamships, which appeared on the Pacific following the annexation of Oregon in 1847,⁸⁷ meant that currents or traditional sailing skills no longer conditioned navigation to the same degree. Besides being the de-facto path for fortune-seeking migrants, the route that developed was also exploited by Pacific South American countries to cheapen their shipping costs to Europe and the Caribbean.

Efforts to build an interoceanic canal through Nicaragua and the geopolitical paradigm at the time resulted in the 1850 Clayton-Bulwer treaty between the U.S. and Great Britain, compelling both countries not to occupy, fortify, colonize, or otherwise exercise domination over Central America. Although there were no Latin American signatories to the treaty, the construction of an interoceanic canal or railway by foreign capital was effectively prohibited in the region. The failure of the Colombian capitalist class to muster enough capital meant that a national venture could not be launched to renew the interoceanic corridor in any form.

The liberal and modernizing outlook of many Latin American elites enabled American capital to become a major agent of landscape and social change. The early industrial revolution in the US had generated extreme concentrations of capital in a few hands, and these assets became increasingly important in regional diplomacy. In 1846, the Mallarino-Bidlack treaty between New Granada and the US granted rights of way across the isthmus to the US. An American corporation, the Pacific Mail Steamship Company, won a bid and was awarded a land monopoly to construct a railroad. The director of Pacific Mail, William H. Aspinwall, was one of these outward-looking barons,

⁸⁷ John Haskell Kemble, *The Panama Route, 1843 – 1869* (Berkeley: University of California Press, 1943), 143.

and would promote the Panama Railroad Company as the chief organizer of the construction of the railroad line from 1850 to 1855.

Following the collapse of the Spanish fleet and fair system in 1739, the interoceanic route had fallen into disuse and relative neglect. As historian Aims McGuinness writes, “transportation across Panama at the beginning of the gold rush was still highly decentralized.”⁸⁸ The early gold-rush conveyance of immigrants, gold, and letters from the U.S. across the transit region was controlled by small operators with at most a few mules or bongos. Due to the demand for rapid transportation and the archaic infrastructure, McGuinness notes that from 1848 to 1852, the history of Panama’s transit system was marked by the transformation “from a locally controlled network powered primarily by human beings, mules, currents, and the wind to a more centralized and largely US- owned ships and locomotives powered by steam.”⁸⁹

However, the takeover of interoceanic communication in the transit region was not completed overnight. The railroad technocratic elite first had to “wrest control of Panama’s transit system from the boatmen, muleteers, washerwomen, and others in Panama who also saw the potential to profit from the great migration to the goldfields.”⁹⁰ But instead of just a social reorganization of labor associated with the route, the railroad entailed a limited transformation of landscapes in the transit region to better adapt its environs integrally to the new flow. Aspinwall’s plans included the construction of a whole new terminal town on the Caribbean coast. The modern city of Colon,⁹¹ located on a peninsula on Limon Bay west of Portobelo, traces its origins to this perceived need.

⁸⁸ Aims McGuinness, *Path of Empire*, 9.

⁸⁹ Ibid..

⁹⁰ Ibid., 55.

⁹¹ To the dismay of Colombian authorities, the name of Colòn was interchangeably used with that of Aspinwall, hinting at the land monopolies the company and foreigners had in the area and corridor.

Due to the abundant rainfall of the Caribbean slope, its lowland soils were saturated with water. The need for construction material put pressure on the transit region's mangroves. On the Caribbean side of the railroad, its terminal and course were to be located in swamp territory, requiring the first ever large-scale filling of wetlands in the isthmus.

The city of Colon did not attain considerable population size until the mid-twentieth century,⁹² but its establishment along an almost straight line from Panama City was necessary for the railroad's effective annihilation of space through time. Panama City, where mule trains were laden in the plaza during the Spanish years, remained the Pacific terminal and "was dramatically transformed into a crowded place of frenzied commerce and breathless anticipation."⁹³ Although at the time it was not much more than an isolated Pacific outpost due to the decline in importance of the transit region, it quickly became a cosmopolitan center where varied travelers congregated while waiting for their steamer for San Francisco.

A restive state of social metabolism yielded to the vicissitudes of transnational capital, which summoned boiler iron bridges, culverts, and trestles to the transit region's landscape and waterscapes. The company was given a great amount of land to use for the route. Implementing the company's vision required the migration of a transnational labor force – including "coolies," Irishmen, Jamaicans, among others – who fell at a 50-80% mortality rate during the construction period.⁹⁴ The construction of the interoceanic railroad was a monumental task for its time, and required new forms of social and labor organization. The environment posed vexing engineering challenges, as the tracks passed

⁹² Nonetheless, by 1852, the yankeeized town had large warehouses, three or four hotels, a red light district, and housed 2000 residents.

⁹³ McGuinness, 4-5.

⁹⁴ *Ibid.*, 192.

over mountains and through former wetlands. Over 300 bridges and culverts were constructed along the route, representing a significant intervention in local ecosystems.

Besides the astronomical death rate and hideous working conditions, the railway's completion was further complicated by the fact that most woods rotted in this climate and thus did not make good material for ties. While the ballasting for the tracks was completed throughout the entire line of the road, the spruce, pine, and native wood ties decayed rapidly.⁹⁵ It was not until the discovery of the properties of the black guayacum (*Lignum vitae*) that the builders obtained a tropical hardwood with the necessary strength, toughness, and density to overcome the heat and humidity. The logs were brought from Colombia, and their formidable hardness meant that construction required drilling the ties before the spikes could be nailed.⁹⁶

Construction of the railroad's Atlantic section had to contend with the obstacles posed by the tortuous Rio Chagres. George Muirson Totten, chief engineer of the project, complained about the area where the Rio Chagres' tributaries ran closer to the "upper part of the Rio Grande" which "presented a wild, broken country, with sharp projecting hills, and deep ravines." The cuts in this area "contained large quantities of rock." Nonetheless, the Pacific section builders found an ally in the Rio Grande valley. Muirson Totten moves from a lengthy account of how the line traversed the Caribbean slope to describing its course across the continental divide to the Pacific:

The line passes the summit ridge by a cut one quarter of a mile in length, and twenty-four feet in greatest depth; and then strikes the head-waters of the Rio Grande.... Following the left bank of

⁹⁵ Fessenden N. Otis, *Isthmus of Panama History of the Panama Railroad, and of the Pacific Mail Steamship Company* (New York : Harper and Brothers, 1867), 40.

⁹⁶ Samuel James Record, *Lignum Vitae: A Study of the Woods of the Zygophyllaceae with Reference to the True Lignum-vitae of Commerce--its Sources, Properties, Uses, and Substitutes* (Yale University: School of Forestry, 1921) 33.

this stream... the line crosses the Rivers Pedro Miguel, Caimitillo, and Cardenas, near their entrance into the Rio Grande; thence it stretches across the Savannas of Corasal [sic], and the swamps of Corendu [sic], and cuts through the spur of the hill Ancon... reach[ing] the Pacific Ocean at Playa Prieta, in the northern suburb of the city of Panama.⁹⁷

Moreover, he claims that “From the crossing of Pedro Miguel to the Pacific Terminus, the work was generally of a light character—the line being down upon the river flats.”⁹⁸

The Panama Railroad’s selected route, almost paralleling the colonial mule roads leading to the fluvial port in the Rio Chagres, meant that, as Tejeira Davis explains, the Rio Grande stopped being a “backwater” to the human flows of the transit region.⁹⁹ The colonial routes were always separated by swamps from the river, but the facility afforded by riverbanks to railroad engineers brought the ‘iron horse’ to its alluvial lands, changing the character of the former strictly agricultural valley.

The first complete voyage between termini ran in 1855, and the effective transit time across the isthmus was reduced to about a half day, if one had the dollars to afford it. Despite the steamers and trains’ dependence on coal, the functioning of the corridor continued to rely on draft animal power. Mules energized the unloading, loading, and coaling of ships at the wharves; ships, carrying up to two or three tons of cargo and the luggage of 700 travelers, were stevedored in as little as two hours. The railroad’s profitability and traffic volume restored the area’s distinctive transithmian economy. The first years of full-length operation were shaped by competition between different

⁹⁷ John Muirson Totten, *Communication of the Board of Directors of the Panama Railroad Company to the Stockholders* (New York: J.F. Trow, 1855), 22-23.

⁹⁸ Totten still notes that “This section, however, included some deep cuts and long banks, the construction of which during the rainy season, from the nature of the soil which was encountered, presented many difficulties.” *Ibid.*, 23

⁹⁹ Tejeira Davis, *Ciudad del Saber*, 15.

steamship companies, but gradually the Pacific Steamship Company consolidated a transit monopoly.¹⁰⁰

Rail technology gave humans unprecedented power over space and time.¹⁰¹ The rail-steamship route made it easier to get from Panama to California than to Panama's contemporary capital, Bogota, which lay distant on a 2200 meter high moorland.¹⁰² The environmental impact and degree of landscape change entailed by the railroad exceeded that of the overland-fluvial route monopolized by the Spanish. Besides a new passageway, the first transcontinental railroad created a "new axis of settlement," with a train station being built every four miles on average along the tracks. The last station before reaching the Pacific was named "Rio Grande Station," located close to the river's confluence with its tributary the Rio Cardenas, northwest of Panama City.¹⁰³

The transit region's prolonged and problematic position within transnational networks of migration and accumulation had long-lasting consequences. Panama became a necessary land bridge for Americans trying to reach the newest and most promising territories under Washington's jurisdiction. The railroad line was established parallel to the Spanish mule road, with its sustaining local cattle economy sprawling into the urban hinterland. The route effectively perpetuated the territorial organization of Panama in function of the interoceanic corridor's demands, and split, at least culturally, the cohesiveness of the Colombian isthmus of Panama.

¹⁰⁰ Kemble, 120.

¹⁰¹ The distortion of human's relation to space caused by the railroads was evidenced decades later by the establishment of time zones based on the location of railroad stations in the U.S.

¹⁰² Luis Pulido Ritter, "Modernidad en movimiento: transitismo, cosmopolitismo y transnacionalidad en la ciudad letrada panamena," (Centro de Estudios Latinoamericanos Justo Arosemena, Panama), 4.

¹⁰³ Tejeira Davis, *Ciudad del Saber*, 15.

The Panama Railroad era was of the earliest and most significant encounters between tropical Central America and the U.S.. Under the terms of the Mallarino-Bidlack treaty, American troops landed routinely on the railroad region to maintain the desired level of stability among the passageway's domestic rebels and civilians. However, traversing Panama put gold-hungry and entrepreneurial Americans in contact with the 'natives.' This early encounter is historically significant because it gave Americans early images of later (virtual) neo-colonial subjects.

The racist and white prevailing supremacist ideologies prevailing in U.S.'s Antebellum culture shaped early accounts of Panamanians. A discourse on the tropical world had begun to take form in North Atlantic societies, especially in temperate Europe. This new perception of the tropics defined the Neotropical world by juxtaposing it with Europe; its climates, peoples, vegetation, and diseases posed a threat to the sub-tropical normalcy. Ideas about race accompanied this assessment of the darker biome, later reinforced by the systematization of a Social Darwinist worldview in the North American academy. As Nueva Granada first fell under the influence of the United States, this new way of perceiving tropical ecosystems found its way to the isthmus' cultural scene. Moreover, according to Stephen Frenkel, the category of the *tropics* in the specifically American social and environmental imaginary, was born, or at least greatly shaped during the construction and operation of the railroad. This culture of nature transposed to the Panamanian tropics brought along an ideological baggage that would help legitimate further intervention in Panama and possibly elsewhere in tropical America.¹⁰⁴

¹⁰⁴ Stephen Frenkel, "Jungle Stories: North American Representations of Tropical Panama", *Geographical Review* 86 (1996), 317-33; and "Geography, Empire, and Environmental Determinism," *Geographical Review* 82 (1992), 143-153.

After the completion of the railroad, the isthmus, still a part of New Granada, received the scholarly attention of American natural scientists, as would other narrow areas of Central America during the search for a feasible waterway site. This development was part of a major reconnaissance of lands previously uncharted by whites throughout the world. Between 1870 and 1873, an American expedition led by Lieutenant Thomas O. Selfridge, enlisting G. A. Maack as chief geologist, was entrusted with scouting Panama's potential for a possible canal route. Although not without alternatives and political squabbling, the isthmus of Panama's legitimacy as a viable site for the first interoceanic waterway was consolidated.

THE FRENCH CANAL 1880 – 1894

North Atlantic societies in the Old World shared a neoclassical notion of hydraulic engineering dating back to the eighteenth century. In this Enlightenment tradition, the “‘proper’ channel for a river is not necessarily the one it has carved for itself: By means of canals and locks it can be guided by men [sic] along a straight and level line.”¹⁰⁵ During the nineteenth century, industrialized nations were able to develop networks of navigation canals connecting their territory to a degree unprecedented in human history. However, natural geologic processes and colonialist expansion had determined that the dreamed interoceanic canal would have to be built through Neotropical territory, where many cultures still held to pre-industrial, non-capitalist patterns of water and resource use. The construction and control of an interoceanic canal would be an important asset in an emerging imperial scene in which the domination of nature through technology granted economic benefits and international prestige.

In the mid-nineteenth century, “modern transportation and communication systems,” writes historian Jessica Teisch, “helped set our modern world in motion.”¹⁰⁶ Social metabolism between mankind and nature accelerated following gradual changes accruing in the repertoire of western environmental management. Applied forms of scientific knowledge— especially civil engineering, fluid mechanics, and hydraulics—

¹⁰⁵ John Seelye, *Beautiful Machine: Rivers and the Republican Plan, 1755 -1825* (New York: Oxford University Press, 1991), 8-9.

¹⁰⁶ Jessica B. Teisch, *Engineering Nature: Water, Development, & the Global Spread of American Environmental Expertise* (Chapel Hill: University of North Carolina Press, 2011), 2.

increased mankind's capacity to transform landscapes with engineering works of unprecedented scale. By the 1870's, coal had overtaken charcoal as the main fuel for producing iron products, while western metropolises had adapted to the potential of oil and natural gas as energy sources. Furthermore, Teisch claims that beyond a quantitative intensification of interconnectedness, "the application of iron, steel, and fossil fuels to industry, transportation, and communication changed the way that people and nations interacted."¹⁰⁷

The construction of an interoceanic canal would require the cultural diffusion of these technologies from the center to the periphery of the world system. A growing faith in the progressive, transformative power of technology ensured a receptive response to this transmission from neocolonial elites. The social contexts that nurtured the emergence of modern hydraulics were imbued in the nature and applications of these knowledges, bringing along a new host of contradictions to the colonial world. Moreover, these technologies enabled the large-scale transfiguring of nature into natural capital, introducing 'new' ecosystems into transnational systems of profit and empire-making schemes. For example, within the cultural philosophy of the era's hydraulic science laid a fundamental contradiction between sustainability and continued capital accumulation, in addition to environmental assumptions about Neotropical hydrology.¹⁰⁸

In 1869, the same year a man-made waterway once again linked the Red and Mediterranean seas cutting through the mostly desertic Isthmus of Suez, Mexico City would launch the construction of its long awaited *Gran Canal*, a massive artificial body

¹⁰⁷ Ibid.

¹⁰⁸ As Carse puts it, "Engineered technologies are embedded with this historical assumptions about economy, society, and environment, which they carry into worlds in flux." Carse, *Beyond the Big Ditch*, 220.

of water to address the city's everlasting sewage problem. The advent of the Second Industrial Revolution coincided with the *Porfiriato*, Mexico's prolonged nation-making dictatorship. Besides the British capital and financial backing, both projects were examples of similar statist projects boasting of their nation's triumph over nature. Late nineteenth century Mexico City's efforts to address endemic floods brought the first steam shovels and massive dredges to Latin America. These massive, mobile machines were the largest ever employed by humans.¹⁰⁹ The use of heavily capitalized technology to exert a particular human vision over nature also requires similarly forceful manipulation of laborers, as the hydraulic society thesis would maintain. Mexican historian Luis Aboites calls the decade of the 1880s "the Great Hydraulic" era, a process in which hydrological resources were to be exploited as a condition for the flourishing foreign direct investment in Latin America.¹¹⁰ This regional process of change illustrates the fact that as 'man' attempted to assert control over nature, he had to do so over his fellow brothers and sisters first.

The French were the first to attempt the hydrologic holy grail of merging the world's oceans at the isthmus' waist. The best route to attempt a sea-level canal, it was determined, was located in the historic transit region. Through the eyes of foreign canal-building engineers and entrepreneurs, the appreciation of the natural world, and tropical ecosystems especially, is reduced to appraising single elements of nature for their potential economic value. Seen from an industrial-hydraulic perspective, the isthmus is thus abstracted and compartmentalized down to its physical and hydrologic elements,

¹⁰⁹ Shawn William Miller, *An Environmental History of Latin America* (Cambridge: Cambridge University Press, 2007), 139 – 141.

¹¹⁰ Luis Aboites, "Relacion Sociedad-Naturaleza desde la Historia de los usos del Agua en Mexico," 1999, in Garcia Martinez Bernardo y Alba Gonzalez Jacome, ed., *Estudios sobre Historia y Ambiente en America* (México: Instituto Panamericana de Geografía e Historia, El Colegio de México, 1999).

rendering it an exploitable geo-hydrological canvass. It featured four main longitudinal ridges. Two of these run parallel to the coasts and the other two down the middle of the landmass. The area's topography features three valleys, "not unlike the spaces between the fingers of a man's hand," which are "practically continuous except where eroded through by the Isthmian streams."¹¹¹ This condition left "four fundamental engineering ways" for the construction of a deep water canal:

- A sea-level cutting from ocean to ocean through the four ridges
- Sea-level sections at each end and a high lake between the two central ridges
- Lakes in the two valleys next the coasts and a cutting through the central ridges
- Lakes in each of the three basins¹¹²

Early in the planning stage, it became clear that the largest task at hand was how to win control and manipulate the region's rivers, in addition to piercing the continental divide at its lowest point. The projected line was crossed by the unruly Chagres River twenty-eight between Gamboa and Colon, and thirteen times by the Rio Grande between Culebra and Panama. "To prevent these rivers from entering the canal and to avoid the currents and dangers of overflow that would otherwise follow, channels or derivations are cut," an American engineer analyzing the French effort in hindsight explains, "to accommodate the waters of the rivers and to carry them to the sea in beds on each side of the canal."¹¹³ The stage of ecological science and environmental thought in the nineteenth

¹¹¹ Lindon Wallace Bates, *The Panama Canal* (Lindon Bates, 1906), 9.

¹¹² *Ibid.*

¹¹³ Charles Rodgers, *Intelligence Report of the Panama Canal* (Washington, D.C.: U.S. Government Printing Office, 1889), 36.

century, however, did not recognize that diverting water from natural streams and rivers caused irreparable damage to riparian wetlands.¹¹⁴

The Rio Grande figured prominently in French plans for a sea-level canal, and also in their later remedial plans to build a lock-canal. The Rio Grande's basin had to be conquered, although the challenge would not be as difficult as the taming of the formidable Chagres. Paralleling the railroad, the northwest-southeast line drawn by engineers across the transit region's slopes intercepted the axes of both rivers, from the point where they debouch from the highlands and turn toward the oceans. Partial derivation and damming of the Rio Grande was an important part of the work done by the Pacific section of the construction crew.¹¹⁵ On a hill close to the river's middle basin, the French began the erection of a dike on the west bank. The dike was the beginning of a proposed dam to enclose a harbor close to Panama City, and would help "close these little rivers and have the main entrance at La Boca."¹¹⁶ Besides riverine sedimentation, particles carried by ocean currents could also obstruct the Southern navigation and access channel. The shallow harbor and tidal conditions at Panama Bay were to be addressed with a tidal lock, which never materialized.¹¹⁷ French engineers never fully grasped the hydraulic challenge posed by the Rio

Around 20, 000 workers, almost all from the West Indies, came to labor on the effort. The need to provide potable water to the workforce necessitated the creation of reservoirs, since no natural lakes existed in the transit region. The Rio Grande Reservoir

¹¹⁴ Jeffrey K. Stine, *America's Forested Wetlands: From Wasteland to Valued Resource* (Durham, N.C.: Forest History Society, 2008), 14-15.

¹¹⁵ Charles Rodgers, *Intelligence Report of the Panama Canal 1889*, 21-22.

¹¹⁶ Report of the Board of Consulting Engineers for the Panama Canal (Washington: Government Printing Office, 1906), 318.

¹¹⁷ McCullough, *Path Between the Seas*, 119.

was built in the upper part of the river between 1882 and 1889, covering an area of 72.77 acres.¹¹⁸ The French intended to use the area's abundance of precipitation in their favor, even if the choice of a sea-level canal hindered a more utilitarian approach of hydrologic features. Although the Panamanian Cordillera reaches its lowest point in East Central Panama, it doesn't completely fade; thus, a canal would inevitably have to traverse a mountainous spine; the obstinate will to claw a sea-level canal between the seas ignored the isthmus topography and geology

In the lower Rio Grande, at La Boca, the French erected the necessary works for the construction of dredges and other machinery. The prevailing miasma theory governing disease epidemics, which linked "illness to the exposure to vapors emanating from marshes rife with rotting vegetation,"¹¹⁹ shaped the appreciation of lowland fluvial landscapes. John Bigelow, an American observer of the French effort, described the infrastructure at the mouth of the Rio Grande as "constantly exposed to the pestilential exhalations of the mangrove swamps through which that stream finds its way to the sea, and through the bed of which the canal is expected to flow. To keep up the force requisite for the mechanical operations to be carried on at this point," Bigelow surmised, "will prove extremely difficult, on account of its insalubrity."¹²⁰

The attempt to build a sea-level canal, like Ferdinand de Lesseps had done at Suez, doomed the Canal from the start. Malaria and yellow fever did not distinguish between Antillean Creole or Parisian engineer, and as the vectors of these tropical diseases were given more range to expand with the excavations, the result was

¹¹⁸ C. Dwight Marsh, "Report on Freshwater Copepoda," 61.

¹¹⁹ Stine, *Americans and Wetlands*, 7-8.

¹²⁰ John Bigelow, *The Panama Canal Report of the Hon. John Bigelow, Delegated by the Chamber of Commerce of New York to Assist at the Inspection of the Panama Canal in February* (New York: Press of the Chamber of Commerce, 1886), xix.

approximately 22,000 work-place casualties. The state of science and technology at the time meant that the French did not a proper understanding of the public health and engineering obstacles at hand.

De Lesseps had planned a sea-level canal and pursued it at appalling human costs. The physical reality was that the topography and character of Panama were wildly different from that of the sandy dunes conquered in Egypt. Skyrocketing mortality, heavy rains, an earthquake, and mudslides hindered excavations. The deforestation, explosion-aided excavations, wetland transformation, and social change brought about by the French project all helped establish Panama as the definitive setting of this millennial dream of uniting the oceans, while smirching its name in the Old World for good. The corruption-laden collapse of the French enterprise created popularized the word *Panamiste* (Panama) as a synonym for graft and corruption in Europe, discouraging other powers from retaking the project.¹²¹ The failure even helped bring down one of France's hero, de Lesseps, and the Third Republic.¹²²

The French project of linking the two coasts of Colombia's isthmus of Panama occurred at a time when the market economy and modernization was straining the relationship between indigenous peoples and post-colonial states throughout Latin America. These relations became particularly contentious toward the end of the nineteenth century, as export booms throughout the region exacerbated encroachment upon indigenous territories. The Pacific coastal region, spanning 11,300 kilometers from Panama to Ecuador was home to the one of the largest black Latin American population, and was left after emancipation a relatively autonomous peasantry. During the same

¹²¹ Matthew Parker, *Panama Fever: The Epic Story of the Building of the Panama Canal* (Random House LLC, Mar 10, 2009).

¹²² *Ibid.*, 87.

period, the larger Caribbean region roughly from Cartagena to Colon was home to an independent peasantry that was being increasingly marginalized by the expansion of cattle ranching. Leal and Van Ausdal assert that “black people there achieved more autonomy than almost anywhere in the Americas, and developed an egalitarian society thanks to a rainforest economy that did not rest exclusively on land and cutting down the forest.” However, the liberal, export-oriented land-use regimes depended on destroying tropical rain and dry forests for monocultures,¹²³ painting a dire future for the continuity of these communities.

The French vision for a waterway, just like the railroad preceding it, did not presuppose the control of non-essential lands for the flow of transisthmian traffic. The French had acquired the rights for an interoceanic canal from Nueva Granada (Gran Colombia), but had not requested autonomous sovereignty over any adjoining land proper, and relied mostly on personal fortunes to subsidize the ill-fated project. Despite their imperial tradition, the French did not have demonstrable colonial objectives in the transit region. Marixa Lasso argues from an analysis of cartographic representations of the project, the French did not have plans to claim any land beyond the projected waterway’s bed, their maps projecting a canal line drawn with exclusively navigational goals and respectful of local settlements along the line. Moreover, Panamanian elites had no reason to fear a takeover of territory due to the excavation of a sea-level canal funded by small bondholders. French engineering maps, as Lasso keenly observes, portrayed the canal line as embedded in a human-inhabited transit region, crisscrossing populated landscapes, and conveyed a “sense of continuity between the canal and previous historic

¹²³ Claudia Leal and Shawn Van Ausdal, “Landscapes of Freedom and Inequality: Environmental Histories of the Pacific and Caribbean Coasts of Colombia,” (Desigualdades.net. Working Paper, No. 58, 2013).

uses of the transit route.”¹²⁴ The towns of the transit region, including some of colonial origins and others whose roots trace back to the railroad era, were adequately represented and factored into construction.¹²⁵

In the second half of the nineteenth century, population began to grow with a renewed vigor in the isthmus. By 1880, the population finally reached pre-conquest levels, but only a small fraction lived in the transit region. “Despite the amount of activity that these works inspired,” Stanley Heckadon argues, “changes to the environment were confined to the immediate surroundings of the towns and camps which sprang up along the railroad line or near the excavations for the canal.”¹²⁶ Beyond the studies done for the railroad, the U.S.-led surveys of potential routes, and studies accompanying the French attempt to build a waterway, the isthmus geography remained unknown for North Atlantic societies. After the failed French effort, more geologists and, for the first time, paleontologists arrived in Panama.¹²⁷

After their machinery rusted under the humid heat, and a chunk of the Rio Chagres’ basin had been deforested by *machete*, Culebra still stood 59 meters on top of the soil supposed to be carved. The Rio Grande was an important component of the French effort (1881 - 1897), and a significant part of its course was to serve as the main channel in the Pacific slope. The incomplete derivation and damming of the upper Rio Grande were the first major transgressions on the physical integrity of the watershed, despite millennia of human dwelling.

¹²⁴ Marixa Lasso, “A Canal without a Zone: Conflicting Representations of the Panama Canal,” *Journal of Latin American Geography* 14, no. 3 (2015), 166.

¹²⁵ Ibid.

¹²⁶ Stanley Heckadon Moreno, “Impact of Development on the Panama Canal Environment” *Journal of Interamerican Studies and World Affairs*, Vol. 35, No. 3, Special Issue: The Future of Panama and the Canal (1993), 133.

¹²⁷ Rodriguez Mejia et al., *Historia Natural del Istmo de Panama*, 4.

THE “BIG STICK”

It was not until the Second Industrial Revolution matured that human culture developed the capacity to stop nearly any river, no matter how mighty. The structural use of concrete became a common practice in Western engineering, to a degree not seen since the times of the Romans.¹²⁸ Throughout the Caribbean, during the initial period of the formation of a working class, foreign capital was increasingly being directed towards large, extractive infrastructure projects, bent on tapping into the traditionally agrarian region's natural capital.¹²⁹ Similar to the era of the California Gold Rush and the Panama Railroad, developments and historical forces operating within the U.S. are essential for unpacking environmental change in early twentieth century central Panama.

During the first decades of the twentieth century, North Atlantic states came to control an overwhelming majority of world space.¹³⁰ The U.S. shared the colonial impulse of the great powers at the time, and American expansionism found clear expression in the manhandling of Spain and takeover of colonies as far as the Philippines. The Gilded Age period in late nineteenth century U.S. history witnessed the closing of a once seemingly inexhaustible internal frontier, one that had an important effect on American society and shaped its relationship with nature through the concept of

¹²⁸ Shawn William Miller, *An Environmental History of Latin America* (Oxford University Press, 2007), 158.

¹²⁹ George Reid Andrews, “Black Workers in the Export Years: Latin America, 1880 – 1930,” *International Labor and Working-Class History* 51 (1997), 15

¹³⁰ Europeans “increased their share of control over world space from 35 percent in 1800 to 85 percent in 1914.” Richard Peet, “The Social Origins of Environmental Determinism,” *Annals of the Association of American Geographers* 75, no. 3 (1985), 311.

“wilderness.” The closing of this frontier posed a de-facto spatial barrier for uninterrupted capital accumulation. John Soluri points to the “increasing availability of once ‘exotic’ and expensive goods produced in the tropics” as representing “an everyday sign of rising U.S. hegemony in tropical Asia and Latin America.”¹³¹ However, a “strictly mercantilist view,” Alexander Missal argues, “does not suffice as an explanation for U.S. policies abroad and their support at home around the end of the nineteenth century.”¹³²

The overseas expansion of the U.S. was galvanized by intellectuals and policy makers who systematized an outwardly looking popular sentiment. For the purposes of environmental change in Panama, the most important of these thinkers, beside Theodore Roosevelt, was Captain Alfred Thayer Mahan (1849 - 1914); his views are expounded in his 1890 landmark study, *The Influence of Sea Power upon History*. Rather than a monument to global commerce and cooperation, the Panama Canal was conceived as a symbol of authority and power, its main utility being that of ensuring the advantage in mobility to U.S. warships. The logic of foreign military post establishment, which took the form of grand scale military bases during this period of industrialized warfare, was an intrinsic part of the neocolonial project, and thus an important determinant for the need of building an interoceanic waterway and acquiring rights to adjoining land. A mercantilist impulse, compounded by a military desire to project power, put American society at an imperial crossroads.

¹³¹ John Soluri, *Banana Cultures: Agriculture, Consumption, and Environmental Change in Honduras and the United States* (Austin: University of Texas Press, 2006), 220.

¹³² Alexander Missal, *Seaway to the Future: American Social Visions and the Construction of the Panama Canal* (Madison, WI: University of Wisconsin Press, 2008), 27.

During the late nineteenth century, the development of landscape and environmental management in the U.S. was an element of the emergence of a new liberal state, as the government responded to social and conservation problems at home and abroad.¹³³ Population growth and a developing environmental awareness coincided with advances in technology, medicine, and empire building, enabling qualitative changes to the nation's environment making practices. These developments were preconditions for even attempting to encroach into tropical America and to alter the waterscapes to the extent necessary for the isthmian canal. The geographic and cultural juxtaposition of the U.S. and the tropical world made the tropical biome "the dominant environmental imaginary of extracontinental U.S. expansion, just as wilderness was for continental expansion."¹³⁴ American cultural attitudes toward nature and the non-human world were embodied in its pragmatic and reductionist hydraulic technique. The influence of this technological assemblage upon landscapes, both social and biophysical, would increasingly impinge upon Central American and Caribbean spaces during the early twentieth century.

In 1902, the Conservative victory in the civil war known as the Thousand Day's War, which engulfed Colombian national affairs and had devastating effects on the isthmus, compelled T.R. to take drastic measures to assert his imperial vision. Roosevelt resorted to American exceptionalism, recently enshrined in the Platt Amendment; by doing so, the U.S. employed a RealPolitik-driven, empire-building approach to

¹³³ For the emergence of a liberal state in the U.S., see Natalie J. Ring, *The Problem South : Region, Empire, and the New Liberal State, 1880-1930* (Athens, GA.: University of Georgia Press, 2012). For this process in the specific context of the Central America's relation to the U.S., see Paul Sutter, "Tropical Conquest and the Rise of the Environmental Management State: the Case of U.S. Sanitary Efforts in Panama," in A. W. McCoy and F.A. Scarano, eds., *The Colonial Crucible : Empire in the Making of the Modern American State* (Madison, Wis. : University of Wisconsin Press, 2009), 317 - 28.

¹³⁴ Sutter, "Nature's Agents or Agents of Empire?," 727.

appropriating the space for the route. The executive branch instigated an oligarchic revolt on the isthmus. In order to secure the territory surrounding the canal, the U.S. intervened in Panamanian politics in 1903 in order to incite a revolution that (successfully) broke ties with Bogotá and established a nominally independent Panama. The result was an “independent” state, in the purest nominal sense, standing as a brazen compromise between native and foreign elites masked in the contemporary façade of banana republics.

The result of U.S. intransigence, the infamous Hay–Bunau-Varilla Treaty of 1903, did not boast a single Panamanian signee, granted extraordinary power and jurisdiction to the U.S. in the isthmus to build the canal. Due to the weakness of the route’s host country, the American canal intelligentsia could alter the very demographics of Panama, if deemed necessary to meet the logistical and managerial challenge of constituting a labor force in a sparsely inhabited former Colombian province.¹³⁵ The U.S.’s continental expansion had been built on a foundation of ethnic cleansing, slavery, and white supremacy. This legacy would be central to the American imposed modes of social and labor organization associated with canal construction, an imprint that ran deeper than in most company towns throughout Central and Latin America or the Caribbean.

The proximity of oppressed West Indians in the Caribbean provided a pool of workers that made the bulk of the workers that ultimately dug the big ditch. Racist attitudes shaped the construction period and the management of the project. The U.S.

¹³⁵ Article II states that the Republic of Panama grants “to the United States in perpetuity the use, occupation and control of any other lands and waters outside of the zone [five miles on each side of the canal’s centerline] ... which may be necessary and convenient for the construction, maintenance, operation, sanitation and protection of the said Canal or of any auxiliary canals or other works necessary and convenient for the construction, maintenance, operation, sanitation and protection of the said enterprise.”

created an effective colony within the isthmus, enabled mainly by domestic collaboration and asymmetric power relations. The Americans deemed the isthmus' labor and productive forces at the beginning of canal construction as inappropriate in myriad ways. The U.S. formed a global labor force in the Zone, which eventually reached upwards of 42,000 workers, exceeding far the number enlisted in the republic's banana monocultures and rivalling the infrastructure overhaul of Cuba's sugar industry or the establishment of the Venezuelan oil industry during the same period.¹³⁶

Although at the outset of the U.S. effort the intent was to build a sea-level canal resembling French designs, the project shifted to a lock and lake based canal soon thereafter. The hydraulics of the Panama Canal and the endeavor to wrest control over the Río Chagres has received recent scholarly attention. The insights of these researchers are especially useful to understand the hydraulic transformation of the Rio Grande valley. Castro Herrera argues that, for the cultural group that envisioned the canal and arranged for its construction, the most salient element of the natural order was the coincidence of a series of biophysical circumstances — geographic location, topography, climate, hydrography. The lessons of the French effort and the American pragmatic approach to hydraulics enabled the adoption of a “technological solution” capable of parlaying into advantages what hitherto had been the waterway's greatest obstacles: heavy tropical precipitation patterns, and a difficult topography.¹³⁷ Ashley Carse's work, exploring the “historical relations between canal administration and the diverse human communities living in the surrounding region,” reminds U.S. that the Panama Canal, similar to other assemblages of “natural infrastructure,” “has been constructed across human groups who

¹³⁶ Reid Andrews, “Black Workers in the Export...,” 15.

¹³⁷ Castro Herrera, *El Agua entre los Mares*, 54.

know and interact with the forest in different ways.” Central Panama’s forests, and by extension its rivers, were “landscapes already morally, economically, and ecologically bound up in agrarian life.”¹³⁸

Paul Sutter argues that aspects of the U.S.’s environmental management in the isthmus worked against imperial interests, mainly those espoused by the Isthmian Canal Commission’s (I.C.C.) sanitation campaign to eradicate the carriers of deadly tropical fevers. Although these diseases were endemic to the region and had already helped defeat one effort at a waterway, “the conditions that produced mosquitoes were not intrinsic to tropical nature *per se* but resulted from the human-caused environmental disturbances that accompanied canal building.”¹³⁹ The immediate consequence of much of the changes on the landscape were catastrophic, as mosquitoes thrived in stagnant pools of water in humid construction sites cleared of vegetation. “This realization,” Sutter observes, “did not mesh well with an American ideology of tropical triumphalism premised on the notion that Americans had conquered unalloyed tropical nature in Panama.”¹⁴⁰

Whereas the French had blamed the winds of the sea, eating apples, or the jungle vapors for their deaths, the U.S. effort was undertaken after the development of the germ theory in the 1890’s, opening the door for the novel idea of insect transmission to gain acceptance among Progressives. This scientific leap uncovered mosquitoes as the vectors of yellow fever and malaria, but its acceptance did not consolidate until years into the

¹³⁸ Ashley Carse, “Nature as Infrastructure...,” 544-5.

¹³⁹ Sutter, *Nature’s Agents or Agents of Empire?*, 724.

¹⁴⁰ “In an imperial context in which technological mastery over nature helped define a nation’s level of civilization,” Sutter observes, the completion of an interoceanic waterway could set the U.S. “apart from the world’s other great powers, to say nothing of the ‘primitive’ peoples who increasingly occupied the American imagination.” Sutter goes further in suggesting that America’s Progressive era technical elite represented a change from previous elites in that its transatlantic connections reflected *imperial intentions*: “an underappreciated aspect of ... transatlantic conversation and one that was formative not just for entomologists but for many other experts within the nascent environmental management state,” 724, 737.

construction of the canal, preventing engineers from knowing that most of their transformations made the problem worse. William Gorgas's led a sanitation and comprehensive mosquito eradication campaign which permanently lowered the risk of contracting a tropical disease in the area, and allowed for the construction to proceed by reducing the death rate among white skilled workers.¹⁴¹ Pneumonia and tuberculosis continued to ravage West Indian workers unabated. Some of Sutter's best examples of these contradictory environmental management practices were taken from the waterscape changes and environmental disturbances that derived from the Rio Grande's basin transformation, the subject of the rest of this section.

The construction period is divided in three stages reflecting changes in leadership. The first stage (1904—1906), headed by American Midwest railroad engineer John Findley Wallace, was doomed by uncontrolled tropical diseases and bureaucratic red-tape mandated by a stingy I.C.C. The lack of a real plan and knowledge of the hydrologic realities condemned this first stage to be a futile attempt to reproduce the French sea-level utopia. American observer wanted the venture to 'Let the Earth Fly,' and a still token workforce struggled to put up digging numbers in vain. Bates gives us a diagnosis of the misguided excavation characterizing this phase, during which putting up impressive numbers of unearthed tropical soil to ensure continued funding trumped all other concerns:

no spoil was going to the dams. They are too far away. None was going to the railway embankments around the lake-to-be; none was going to the breakwaters or valuable reclamations;

¹⁴¹ Although deaths from mosquito-borne diseases decreased across the board, other illnesses such as pneumonia, tuberculosis, and intestinal diseases were still rampant after Gorgas's operation. The 'coloreds' comprising the silver roll ranks, mainly West Indian, died at nearly three times the rate of whites. McCullough, *Path Between the Seas*, 469; John Lindsay Poland, *Emperors in the Jungle: The Hidden History of the U.S. in Panama* (Durham: Duke University Press, 2003), 33.

none to raise Colon. Where? Just to the nearest places, without reference to anything but disposing of the output. The putting of tens of millions of cubic yards of spoil into dams and embankments is a very different proposition from the procedure of this record-striving exhibition.

The second stage (1905—1907) the new chief engineer, the builder of Great Northern Railway John Frank Stevens, set the priority of constructing the civilian and community infrastructure of the Canal Zone before proceeding with letting the earth fly. After the personnel, at least the white skilled workers, was materially provided, Stevens transformed the project with a railroad engineering approach to canal building which led him to implement a rail-based system with shifting tracks that could dispose of the soil from excavation and blasting sites, thereby increasing the effectiveness of the novel Bucyrus steam shovels.¹⁴² Understanding that landslides and heavy rains necessitated brisk and orderly disposal of the soil from the sites of excavation, the identification of landfill sites to absorb massive amounts of earth was imperative.¹⁴³ In order to transform the landscape and waterscape and erect the massive concrete lock chambers, the U.S. brought in: 102 large, railroad-mounted steam shovels, enormous steam-powered cranes able to handle concrete, dredges, giant hydraulic rock crushers, pneumatic power drills, and cement mixers. More importantly, the key to construction success would be the railway system whose main use was to function as a conveyer belt to move loosened soil to places where material could serve U.S. imperial interests: landfills, causeways, earthen dams, and others.

¹⁴² Stevens understood that “the Panama Railroad was the lifeline along which not only men, food, supplies...would have to move freely and efficiently but the Culebra dirt trains as well.” McCullough, *Path Between the Seas*, 474-6.

¹⁴³ These landfills or dumps have a great environmental impact, especially in tropical wetlands. Four of the largest dumps created by the I.C.C. were Tabernilla and Gatun in the Caribbean slope, and La Boca and Miraflores dumps located at the middle and lower Rio Grande basin respectively. Castro Herrera, “*Pro Mundi Beneficio*,” 732.

The plan adopted during this second stage fully displayed the characteristics of a “socio-technical system,” constituted by “technical, organizational, scientific, and political-legislative components.¹⁴⁴” The envisioned canal was a mechanized waterway composed of three sets of locks, three dams, a series of reservoirs, and a “network of remote hydrographic stations from which measurements of rainfall and changes in river and lake elevations from across the watershed are transmitted to a central station.”¹⁴⁵ The Pacific section of the canal was to feature two set of locks due to the nature of the slope, Miraflores and Pedro Miguel locks.¹⁴⁶ Temporary construction towns and permanent *Zonian* towns, both gold-rate (for white civilian and military) and silver-rate (for black and non-U.S.-born), were to be erected within the valley of the Rio Grande and throughout the Canal Zone. The transit region’s savannahs, tropical dry and rainforests, and reclaimed wetlands would give way to a logic devoted to the functioning of an ever more demanding waterway.

Ensuring a freshwater supply for the Canal Zone was one of the earliest and most defining concerns of the U.S. technocratic regime. It was one of the first tasks taken up by the Second Isthmian Canal Commission and considered vital for continued construction. Besides water for lock operation, sanitation for workers remained a priority for the American effort, and the plan for the provision of water adopted was a chain of reservoirs across the isthmus with mains. There were seven reservoirs in the supply plan,

¹⁴⁴ During this stage, T.R. finally approved sufficient funds for Army physician William Gorgas’s radical plan to implement the findings of Cuban epidemiologist Carlos Finlay, regarding the mosquito transmission of yellow fever, within the Canal Zone and adjoining urban centers.

¹⁴⁵ Carse, “Nature as Infrastructure...,” 545.

¹⁴⁶ The largest set of locks, Gatun locks, was to be located in the Caribbean slope to tame the unruly Rio Chagres.

three of which were in the Pacific slope: Rio Grande,¹⁴⁷ Ancon Hill, and Cocoli Lake.

The assemblage of aqueducts and hydrants that accompanied the reservoir enabled an unprecedented control of water drainage and distribution, a prerequisite for mounting the engineering and logistical effort represented by the canal's construction.

U.S. engineers began to overcome the lack of knowledge about the hydrology and geology of the route. The fact that the waterway was determined to be a lock-canal that would be integrated with the ecosystem services of the area forced technocrats to conduct studies of the region.¹⁴⁸ In his treatise on *The Agricultural Possibilities of the Canal Zone*, Hugh Hammond Bennett gives us one of the best descriptions of the stream banks:

“Along the Rio Grande from its mouth to near Corozal and lying between the Panama Railroad and the lower slopes of the Ancon and Sosa hills are about 2 square miles of low, flat, alluvial land which is subject to overflow and which remains in a permanent soggy condition....The soil is a dark colored, very fertile silt loam to clay loam which, with good protection from overflow, such as may be secured by the construction of open ditches and dikes, would produce fine crops of rice, sugar cane, and probably a variety of vegetables. Heavy applications of lime would likely be required to bring this land into favorable condition for healthful plant growth. At present it supports a dense growth of mangrove and other water-loving plants.”¹⁴⁹

Bennett asserts that the lands in the western hinterland of Panama City had similar productive potential as those of silt loam below Gatun Dam, used by natives for growing

¹⁴⁷ The Rio Grande reservoir was the dam initially constructed in the mountainous continental divide by the French. Explaining how Panama City was to be provided with potable water, Burr states: “The source of public water supply selected for the city of Panama is a reservoir in the upper Rio Grande Valley close to the great Culebra Cut and about 1 miles from the city. The dam for this reservoir was constructed in the old days of the old Panama Company by M. Phillipe Buneau-Varilla.” William Herbert Burr, “The Present Aspects of the Panama Canal,” (Washington D.C.: Government Printing Office, 1906), 71-78.

¹⁴⁸ The lock option also meant that any further expansion of the waterway's capacity, in both ship size and traffic, would entail costly constructions of new sets of locks.

¹⁴⁹ Hugh Hammond Bennett, *The Agricultural Possibilities of the Canal Zone Pt. 1* (US. Department of Agriculture, : Washington, D.C.: 1912).

“coconuts, bananas, and other moisture-loving crops.”¹⁵⁰ The most common form of travel was by canoe along the isthmus shore. Forests featured canoe-ready hardwoods such as oaks, *lignum vitae*, and Santa Maria, as well as a myriad of soft-wooded species.¹⁵¹

While the land-use policies of the Canal Zone were not yet established, the hydraulic decisions made by the engineers threatened the continuity of the landscape described by Bennett. The 1906 engineers’ report states that, while some rivers were to be cut off by dams, “others are to be taken into the canal. They must, however, be temporarily diverted during the excavation of the canal; and in the case of the Rio Grande this involves a tunnel seven-eighths of a mile long.”¹⁵²

The transformation of the waterscape truly reached a grander scale during the third stage of construction (1907—1914), under the military leadership of Army officer George Goethals. Despite its advantageous orientation, the Río Grande was a “silt bearing stream” hindering navigation in parts of its course. Its bed was composed of mud, coral, sand and multiple varieties of clay. Nonetheless, U.S. engineers were determined to stop the silt of the Río Grande valley from reaching the Pacific, and subsume its valley into the most important artificial strait in the world. The rest of this section will explain how the valley’s landscapes were radically transformed during the canal’s construction and first decades of operation, when engineers completely transformed the Rio Grande’s watershed, from its upper and middle basins down to the estuary in its coastal mouth. The same environmental problems that doomed the French afflicted the American effort, but

¹⁵⁰ *Ibid.*, 35.

¹⁵¹ *Ibid.*, 20 – 21.

¹⁵² George Whitefield Davis, John Frank Stevens, and John Findley Wallace, *Report of the Board of Consulting Engineers for the Panama Canal* (Washington, D.C.: U.S. Government Printing Office, 1906) xi.

rapid developments in science, technology, and managerial organization of workers increased its chances to succeed.

The upper Rio Grande near its headwaters was virtually annexed to the Rio Chagres via the narrow Culebra Cut through the continental divide. The Culebra Cut captured the Rio Grande's waters for Gatun Lake, virtually uniting two distinct watersheds. The railroad conveyor belt was crucial in getting the unwanted earth out of the way in this continental divide. Throughout the strait, mountains were transformed to reduce their gradient, preventing devastating land and mud slides. The carving of Gaillard cut, as it was originally called by the U.S. engineers, had a traumatic effect on West Indian workers due to historic mortality rates. The Rio Grande reservoir, close to Culebra, was drained by a spillway, and the eponymous, temporary town of Rio Grande was dismantled in 1910.

Beginning in the vicinity of the stream's junction with the Rio Pedro Miguel, the Rio Grande entered its middle basin, where its meandering course carved fertile lowlands. In some locations, the bed of the Rio Grande was linear enough that the I.C.C. was able to straighten and incorporate it into the canal. The Pedro Miguel locks, the first set encountered upon crossing the Cordillera from the Caribbean toward the Pacific, admits water from Gatun Lake, connecting the two largest oceans for human purposes. It is around this area that the Rio Grande starts to form a clear axis with the Rio Chagres.

The Rio Grande valley proved instrumental in cheapening the conquering of the Pacific slope.¹⁵³ The lake on the Pacific slope, Miraflores Lake, was to be created by

¹⁵³ "From Pedro Miguel to Miraflores, 1.5 miles, the descent is more gradual and the valley of the Rio Grande is followed. At Miraflores, the Rio Grande valley is but little above sea and is bordered by highlands on each side nearly to the Gulf of Panama. The distance to the gulf shore from Miraflores is

damming and diverting the Rio Grande in the area between the old town sites and present-day lock sites of Pedro Miguel¹⁵⁴ further north and Miraflores.¹⁵⁵ Engineer H.F.

Hodges explains:

“The lock and dams at Miraflores form a barrier closing the lower Rio Grande Valley and retaining the intermediate level of Miraflores Lake.... The lake receives the flow of the Cocoli, Pedro Miguel, Caimitillo, and Cameron[sic] rivers, all small streams formerly tributary to the Rio Grande. In the rainy seasons the discharge of these streams may be considerable, but in the dry season it reduces to a small amount.... The main supply of this lake then is the water let down from the summit level when passing vessels through Pedro Miguel lock.”¹⁵⁶

The elongated and voluminous lake was more conducive to maritime traffic than the Rio Grande’s course, since its meandering middle course and shallow bed posed challenges for American engineers.¹⁵⁷ A dam was located in the west side of this new lake “to complement the surrounding hills and enclose the lake. The flow from the Rio Grande and Pedro Miguel Rivers, and one or two other smaller streams, also enters the lake.” The dam’s design also presented spillways to capture the flow of tributaries to “prevent the water from giving trouble in the valley below the locks.”¹⁵⁸ During the lake’s construction, the Rio Grande’s tidal interaction necessitated the erection of dike “to protect the pit against flooding by the tidal waters in the river bed.”¹⁵⁹

about 5.5 miles.” *Engineering and Contracting* 41, vol. 1 (Chicago: Myron C. Clark Publishing Company, 1914), 27.

¹⁵⁴ Ibid.

¹⁵⁵ The old town site, a lake, a landfill, and a set of locks all share the name ‘Miraflores.’

¹⁵⁶ H.F. Hodges, “General Design of the Locks, Dams and Regulating Works of the Panama Canal,” in *The Panama Canal II: Design and Erection of Structures, Transactions of the International Engineering Congress* (1916), 45.

¹⁵⁷ “The line from Pedro Miguel on was practically a straight line to deep water in the Gulf of Panama.” *Engineering and Contracting* 41, 27.

¹⁵⁸ Reuben Edwin Bakenhus, *The Panama Canal*, vol. 2, Institute Proceedings 39 (United States Naval Institute, 1913), 650; *Excavating Contractor 1913- 1914*, vol. 10 (1913), 133.

¹⁵⁹ *Excavating Contractor 1913- 1914*, 15

“This dike, composed of a trestle fill of rock and earth, prevented the water from the sealevel channel from entering the steam shovel cut 5,000 feet long, 500 feet Wide, and 4-6 feet below mean tide, extending to Miraflores Locks.¹⁶⁰

The Miraflores locks, a twin-chamber set of twin locks abutting the spillway, was/is the southern terminus of the lake. From Miraflores, “a channel 150 ft. wide with side slopes of 1 on 3 was to be excavated to La Boca.”¹⁶¹ The lake allowed the construction of a hydroelectric power substation and a water purifying plant to supply the Canal Zone’s and Panama City’s needs.¹⁶²

On August 23, 1913, the Rio Grande, which had been temporarily diverted, was “turned into” the pit created by the earthen dike soon to become Miraflores Lake.¹⁶³ The artificial lake logically had negative environmental consequences- albeit in a smaller scale than those caused by the creation of Gatun Lake in the Caribbean. Besides submerging 1.6 miles of fluvial lands, the project also destroyed wetlands by filling them with rock and earth. The Miraflores dump, located between the Cardenas river and the railroad track, reclaimed the land upon which fort Clayton was built.¹⁶⁴

Through the Rio Grande’s middle and lower course, floodlands predominated, especially alluvial lands that had been historically used for livestock and tropical market agriculture. American environmental ethics brought a different regime of land-use, felt particularly by the transit region’s wetlands and mangrove forests. Representations of

¹⁶⁰ Ibid.

¹⁶¹ “This channel, stated to be mostly through low swamp country and to be 4.12 miles long, 200 ft. wide on the bottom and with slopes of 1 on 3, was to extend to the 8-fathom line in Panama Bay.” Ibid., 27.

¹⁶² Reese and Reese, 59.

¹⁶³ *Excavating Contractor 1913- 1914*, 15

¹⁶⁴ This military base grew spatially and demographically during the first half of the twentieth century. Today its urban core is the site of the City of Knowledge, a public-private research institution established in the repurposed base after the transfer of the Canal Zone lands back to Panamanian jurisdiction. On the other hand, Miraflores lake remains the only artificial lake of the Panama Canal Watershed from which water is drawn exclusively to power locks instead of a mixed use, including potable, industrial, and lock-use.

vapor-emanating marshes rife with rotting vegetation had left a deep imprint in the American environmental imaginary. Although the germ theory of disease was gaining acceptance in the transnational scientific community, Stine argues, “the wetlands themselves remained under a cloud of suspicion.”¹⁶⁵ The mosquito theory raised new doubts about the healthfulness of insect-breeding swamps, further associating wetlands with pestilence. While cases of bad science producing appropriate or sustainable environmental practice and engineering have been recorded, the intersection of medicinal and hydraulic knowledges, in this instance, reinforced older, harmful attitudes toward life sustaining ecosystems.

The Rio Grande’s marshy lower basin would receive the bulk of the spoil from the excavations at the continental divide. The tropical estuary located at the river’s mouth, La Boca, allowed tidewater into the lower basin. The general consensus among engineers of the period was that filling these marshlands was the most effective way of building the waterway. A series of landfills, embankments, and dredge-work in the Pacific coast completely transformed the estuary of the mouth of the Rio Grande, creating a single channel. The tortuous course of the river was widened and straightened, strategically submerging “the deadly swamps of the Rio Grande back of Panama.” With little effort, Bates boasted, and “less than a million of money,” the I.C.C. could “transform these breeders of otherwise unconquerable Chagres fever and malaria into the bed of a clear, fresh lake, and the death-giving morasses would be replaced by life-giving waters.”¹⁶⁶ Moreover, these wetland could be further converted into hydraulic resources, “the

¹⁶⁵ Stine notes that “This attitude, “made it easy for cities... to dump their voluminous solid wastes they generated into urban marshlands and thereby create new (and highly prized) building sites.” *Wetlands: From Wasteland to Valued Resource*, 7-8.

¹⁶⁶ Bates, *Retrieval at Panama* (1907), 310.

mangrove thickets afford[ing] splendid material for fascine mattresses in connection with dyke and harbor works.”¹⁶⁷

In the lower Rio Grande, the central destination for debris was the landfill that would become the town of Balboa, the imperial showcase and administration capital, west of Panama City. Bates lauded the decision to reclaim land in the area, since it “add[ed] to the domain of the zone, affording a new and better located and ideally sanitary site immediately adjacent to and seaward from the present town.”¹⁶⁸ However, these new town would by no means be an extension of dangerous, tropical Panama City, but would be a city fit for white civilization to enjoy the benefits of having conquered nature. The transformation of the waterscapes was followed by radical changes on the Canal Zone’s urban landscaping and forestry. The Rio Grande’s mouth would host white, gold-roll Balboa and a silver quarter town called La Boca. Two other military fortifications were built to ‘secure’ the Pacific port and locks in reclaimed coastal areas: Fort Amador and Albrook Air Force Station.

In addition to the connection established between the coastal islands and Balboa, the history of the Rio Grande had been effectively married to the Rio Chagres’s. The Zone’s hydrology would suffer a new major transgression in the name of the everlasting search for water sources. Population pressures on water demands and a long drought extending from 1929 to 1930 acted as the main motivations to secure new sources of water for the storage needs of the watershed.¹⁶⁹ Panama City’s metropolitan area

¹⁶⁷ Bates, *The Panama Canal* (1906), 105.

¹⁶⁸ Bates, *Retrieval at Panama*, 349.

¹⁶⁹ Carse, *Beyond the Big Ditch*, 41.

population in 1905, the second year of construction, stood at 22,000.¹⁷⁰ In 1922, U.S. President Calvin Coolidge authorized the creation of a second dam and reservoir on the Rio Chagres, utilizing its tributary known as Alajuela in its upper basin. Madden lake, currently known as Alajuela lake, was completed in 1936 after the completion of Madden dam, and the area of 22 square miles it occupies were expropriated from Panama, again under the terms of the 1903 treaty.¹⁷¹ Despite this expansion of storage capacity, the political control of waterworks and distribution systems remained a point of contention for U.S.-Panama relations.

A new form of American tropical landscape design and urbanism was shaped in this colonial encounter with Panama's ecosystems. The influence of landscape architects William Lyman Phillips, the pioneer of tropical landscaping, and Frederick Law Olmsted Jr. determined the aesthetics of Zonian planning for decades after the construction period. The Zone's verdant urbanism was a synthesis that anticipated greenbelt towns of the U.S. in the 1930's, while adapting to the tropics contemporary urban tendencies associated with the City Beautiful Movement.¹⁷² During the late nineteenth and early twentieth centuries, a new variant to the philosophy of American forest management was also being shaped in overseas colonies, and might have played a role in the treatment of non-urbanized spaces.¹⁷³ However, there was an imperative to urbanize as little of the Zone as

¹⁷⁰ By 1980, it had ballooned to 700,000. The greatest growth spurts came just after the canal began operating. Omar Jaen Suarez, *Hombres Y Ecología En Panamá* (Panama City: Editorial Universitaria/ Smithsonian Tropical Research Institute, 1981), 86.

¹⁷¹ The threatened Alajuela basin remains a vital cog of the water management regime of the Canal Watershed. The rivers of Lake Alajuela contribute approximately 45 percent of the total water for the canal and regulates the level of the navigable Gatun Lake.

¹⁷² Tejeira-Davis, *Ciudad del Saber*, 49- 58.

¹⁷³ This is a research question that has not, to my knowledge, been explored. Scholars are beginning to look at American forestry in Puerto Rico and the Philippines, for example, to understand how these practices adapted to different ecosystems. See Ian Tyrrell, "Conservation and Forestry in the American Tropics: John Clayton Gifford in Puerto Rico." *Environment & Society Portal*, Arcadia 10 (2015). Rachel

possible, per George Goethals's request, suggesting that forested lands better served the imperial mission for their defensive properties against terrestrial attacks.¹⁷⁴ Although the surviving forests of the watershed might seem to attest to a successful nature conservation scheme, these forests were by no means natural. New species were imported from elsewhere in the Neotropics, including Asia and Africa, and drainage within urban and 'forest' areas was perfected to a point where waters never formed pools.¹⁷⁵

As the U.S. got increasingly involved in the isthmus, as Julie Greene notes, "officials struggled to build a comfortable society for white Americans—one they might proudly call a civilization—in the zone." The initial 100% turnover rate for American officials led to the importation of every luxury and comfort from the imperial metropole. The material inequality between the Zone's paradisiacal Gold Roll quarters and its Silver Roll tenements rivaled the larger contrast between the transit enclave and urban Panama. The Zone benefited from the Canal's hydropower, and Zonians enjoyed electricity before even many factories were electrified in the mainland U.S.

Due to their close proximity to American territories, Panama City and Colon's landscapes were sanitized, rivers and settlements were sprayed with pesticide, streets paved, houses fumigated, screened, and heightened, modern water and sewage systems installed, all in an imperial effort to "pull the teeth" out of the tropics.¹⁷⁶ Ironically, the U.S. government demanded small payments from Panama for these projects, even if the I.C.C. deemed these "part of a bioterritorial effort to buffer white populations and

Carson Center for Environment and Society. <http://www.environmentandsociety.org/node/7042>; and Emily Brock, "American Jungle: Ecology and Industry in the Philippines, 1898-1947," Lecture, Lunchtime Colloquium from the Rachel Carson Center for Environment and Society, Munich, June 26, 2014.

¹⁷⁴ Castro Herrera, *Pro Mundi Beneficio*, 141.

¹⁷⁵ Tejeira-Davis, 61.

¹⁷⁶ Paul Sutter "Nature's Agents or Agents of Empire," 67-90.

infrastructure from human and environmental threats that were, at least in part, byproducts of the construction of the canal itself.”¹⁷⁷ Although Panama’s urban citizens along the transit region benefited from this spill-over of progressive American environmental management, the spatially unequal application of these health measures across the country exacerbated historic inequalities.

Besides its separation from Panamanian ‘natives’ and its landscaping aesthetics, the Zone itself was segregated into a socio-racial hierarchy modeled after the Jim Crow system, reflecting the Silver Roll and Gold Roll binary. The silver label, used to designate “low-skill” and darker hues, denoted the medium used to pay most workers. White colonists, mostly bureaucratic *Zonians*, were remunerated in gold. This unequal system, which also segregated housing on the Canal Zone, created internal borderlands. As Michael Donoghue puts it, “The gold towns of Ancon, Balboa, and Diablo on the Pacific... evolved into sites of safety and comfort for white U.S. citizens. In their psychological geography such communities constituted Wilderesque ‘our towns’ rather than the silver towns of La Boca, Paraiso... that in their eyes denoted blackness, inferiority, and threat of crime.”¹⁷⁸ In La Boca, the silver quarters were deliberately “hidden” from Balboa on the south side of Sosa hill. Balboa, built upon the largest landfill of the Canal Zone, was designed to epitomize the most progressive aspects of American civilization, with carefully manicured ocean drive-ways, a park and plaza system, and strategic port and harbor. Reese and Reese give us a glimpse of how the new commuting patterns in the former estuarine area worked out:

¹⁷⁷ Carse, *Beyond the Big Ditch*, 119.

¹⁷⁸ Michael E. Donoghue, *Borderland on the Isthmus: Race, Culture, and the Struggle for the Canal Zone* (Durham: Duke University Press, 2014), 27.

“Olmsted recommended that the new portion of the tramway line, which was planned to connect port facilities and Panama City be laid around the back of Sosa Hill... bring[ing] ‘native’ workers from the city and black workers from La Boca¹⁷⁹ directly to their jobs without crossing Balboa’s Prado.”¹⁸⁰

In 1956, citing safety concerns due to its location next to the southern entrance of the canal and fuel storage tanks, the Zone authorities removed West Indians from La Boca. Sparing the “dangerous fuel tanks,” officials demolished old wood-and-screen housing, replacing the stock with concrete structures for white Zonians.

Most of the settlements of the Canal Zone, however, were established after the violent depopulation order of 1912. Before this date the U.S. had embraced “a liberal policy toward rural settlement” and smallholders, evident in the surveys of agricultural potential conducted by Bennett. However, as construction works neared a close, this policy was reassessed. The U.S. exercised its legal right to expropriate land deemed necessary for “canal purposes” using force, legitimized through an eminent domain claim. This enclosure, as Carse deftly puts it, “marked the transition” of the Zone’s mission “from transportation as a socio-technical project that could mesh with, and even benefit from, agricultural land using the same region to a government project to produce

¹⁷⁹ In 1956, citing safety concerns due to its location next to the southern entrance of the canal and fuel storage tanks, the Zone authorities removed West Indians from La Boca. Sparing the “dangerous fuel tanks,” officials demolished old wood-and-screen housing, replacing the stock with concrete structures for white Zonians. Donoghue notes that “West Indians still claim that they were pushed out of La Boca because its location caused an undesirable transit of blacks through the white town of Balboa. Others assert that the Zone government acceded to cruise ship officials who disliked the sight of a dilapidated black town at the Canal’s entrance, with ‘niggers fishing and hanging out their underwear.’” *Borderlands on the Isthmus*, 27.

¹⁸⁰ Also, the importation of American suburban planning brought the separation of workplace and residential spaces to the isthmus for the first time. This rapidly spread to Panamanian cities. Reese and Reese, 188- 189.

a landscape that served narrowly defined purposes.”¹⁸¹ American technocrats considered that, within this new logic, “the new Zone ought to be a place that separates North Americans from Panama.”¹⁸² Following the construction phase, all “Antillean” workers were forced to abandon the Canal Zone. Panama City’s neighborhoods close to the former mouth of the Rio Grande, where Afro-Panamanians had settled since the second half of the nineteenth century, mushroomed into much denser slums. Wooden shacks became a fixture in places like El Chorrillo, Calidonia, and Marañon.¹⁸³ These urban residents were effectively transferred from areas with Zonian-provided water services to Panama’s system of water and sewage services.

Article II of the Hay-Bunau-Varilla treaty specifically granted “the United States in perpetuity... the group of small islands in the Bay of Panama, named, Perico, Naos, and Flamenco.” These islands were virtually annexed to the coast via a breakwater and causeway constructed from rock and debris of excavations. This took the form of a causeway meant to protect the entrance channel. This landform diverts crosscurrents that carry soft material from the shallow harbor of Panama City into the canal channel. The causeway linked the islands that had historically served as harbors for Panama City with the mainland Balboa, a complex known as the Causeway Islands of Amador.¹⁸⁴

Conflicts over the use of hydrologic resources surfaced during the first half of the twentieth century, but the asymmetric power of the U.S. and its hegemonic control over

¹⁸¹ As Carse notes, a 1912 census had the Zone’s population at 61, 279. In 1917, following the expulsion of many “natives and colored people,” population had fallen by half. *Beyond the Big Ditch*, 108- 111.

¹⁸² Frenkel, *Jungle Stories*, 329- 330.

¹⁸³ Ritter, 18.

¹⁸⁴ Although serving military interests for most of the twentieth century, since the transfer in 1999, this artificial peninsula has seen considerable development along the palm-lined causeway, or *calzada*, and edges of the islands, including port facilities, marinas, shopping, and restaurants. Away from their perimeters, the hilly islands still contain isolated maritime jungle, under threat by continued development.

land and labor prevented democratic outcomes. In his nationalistic monograph on the history of the Rio Chagres, published at a time of climaxing tensions over the Canal Zone's sovereignty, Bonifacio Pereira denounced the high prices charged by the U.S. to Panama for the provision of potable water and electric power. The purifying plant at Miraflores drew its water from Gatun Lake, which in turn drew most of its water from the newer Madden Lake. This interconnected system of sewer and aqueducts remained in American hands well into the Cold War. A similar arrangement was in place for the provision of hydroelectric energy.¹⁸⁵ In response to recent threats by the Zone's government to cut these services if Panama refused to pay maintenance tolls, Pereira exhorted the Panamanian government to build its own hydroelectric and purifying facilities to curb this dangerous dependency.¹⁸⁶ Besides the outright control of the Zone's space and appropriation of the waterway's profits, the Panama Canal imposed myriad structural limitations on Panamanian sovereignty and prosperity that even today are not fully understood.

Even after its symbolic opening in 1914, the functioning of the Panama Canal entails, to the present day, a perpetual battle against nature, taking the form unending dredging and maintenance with heavy floating machinery. The persistence of mudslides, channel and storage sedimentation,¹⁸⁷ prodigious rainfall seasons, and sprouts of water hyacinth necessitated permanent abatement. The narrow strait linking the Rio Chagres and Rio Grande was an elaborated artifice remade constantly. Near the Rio Grande's

¹⁸⁵ Pereira Jimenez, *Biografia del Rio Chagres*, 166-168.

¹⁸⁶ *Ibid.*, 182-3.

¹⁸⁷ As Stanley Heckadon notes in the context of the canal's relation to the contemporary global market: "deforestation fosters erosion of the soil and contributes to the build-up of sediment in the lakes. Increased sedimentation will make the canal less competitive as a route for world trade." *Impact of Development on the Canal Environment* (1993), 131.

headwaters, the Panama Canal Dredging Division, one of the most important cogs of the canal's infrastructures, was expanded and relocated to the town of Gamboa, close to the Continental Divide on the Chagres.¹⁸⁸ As dredging superintendent John Claybourn justified the relocation to Canal Zone Governor Jay Morrow: "...first as a safeguard in case of obstruction of ... [Culebra] Cut by slides, the logical location being between any dredging and the dumps in Gatun Lake; second [because] increased Canal traffic, as well as the size of the ships, introduces a serious menace to our fleet when moored in the ... Cut at Paraiso."¹⁸⁹

Panama's continued efforts to revise the 1903 treaty finally yielded results with the advent of the U.S. Good Neighbor Policy and the signing of the 1936 Hull-Alfaro treaty. Not ratified until months before the outbreak of the war in 1939, this accord ended the protectorate-status of Panama, curbing unilateral intervention and the undisputed right to eminent domain practiced by Washington for thirty-six years. More important for Panamanian productive activity, commercial interests addressed the harmful smuggling of goods out of the Zone, and obtained access to the Zone's previously forbidden market. The colonial enclave had effectively split the country in two, and this split was evident in food supply networks. Hence, in a stereotypical banana republic and U.S. client-state, the fruit that was consumed in the capital, and logically within the Zone, was being imported from abroad.¹⁹⁰ Nonetheless, calls for Panamanian sovereignty and for truly bilateral approaches to treaty renegotiations were ignored, failing to prevent some of the worst socioecological follies perpetrated by the U.S. in Panama in ensuing years.

¹⁸⁸ The division was formerly located at Paraiso,

¹⁸⁹As quoted in Jorge Ventoncilla and Kurt Dillon, *Gamboa: A Guide to Its Natural and Cultural Heritage* (Panama City: Smithsonian Tropical Research Institute, 2010), 24.

¹⁹⁰ Peter Szock, *La Última Gaviota: Liberalism and Nostalgia in early twentieth-century Panamá* (Westport, CT.: Greenwood Press, 2001), 51.

The domination of the isthmus's tropical ecology and polity virtually granted the U.S. free rein to experiment with environmental racism and pursue its imperial interests unimpeded. As John Lindsay-Polland notes, "Prevailing U.S. attitudes toward the tropical environment, civilization, and race served to rationalize the ways in which the United States pursued its objectives."¹⁹¹ He chronicles different episodes of American abuse of the Canal Zone. Among these uses of tropical ecology, he lists clandestine environmental activities, covert chemical weapons tests, and Cold War training for tropical guerrilla counterinsurgency.¹⁹² Although less obvious than the long-term effect of controlling the hydraulic infrastructure, these episodes altered the country's political ecology in myriad ways, some of which persist into the present-day.

The politics behind the unification of the watersheds of the Rio Grande and the Rio Chagres had a determining effect on the conditions of urbanization in the transit region. At either end of the interoceanic corridor, the presence of the Canal Zone blocked the possibility of a natural suburbanization south of Colon and north of Panama City. Except for the physical and political boundary posed by the Zone, as Donoghue puts it, "urban expansion would have spread out like a concentric fan from these coastal ports. Instead the boundaries of the Zone forced development to the east and west of Panama City and Colon," and in the case of the capital on the Pacific, "creating an elongated metropolis... that still plagues its residents to this day." Moreover, "the results fostered a lightly populated Canal Zone with very dense Panamanian populations at either end of

¹⁹¹ Lindsay-Polland, *Emperors in the Jungle*, 4.

¹⁹² At the time of the transfer of the Panama Canal in 1999, the U.S. refused to acquiesce to any requirement to perform clean-up operations, leaving hundreds of thousands of piece of unexploded ordnance and depleted uranium in the former Zone. Many of these testing sites were located in the historic Rio Grande valley. *Ibid.*, 3.

the enclave.” This “peculiarly warped urban development pattern,”¹⁹³ especially in the Pacific where Panama City’s ecological footprint has grown irreversibly, resulted in the severe environmental deterioration of rivers and potential water resources in the capital’s historic hinterland.¹⁹⁴

The main environmental problems threatening prospects for sustainable development in Panama derive from the destructive expansion of the cattle ranching frontier.¹⁹⁵ A staple of the local economy since the days of the Spanish colonial corridor, The livestock sector was able to exploit a wealthy new market after the restrictions on food imports were lifted with the aforementioned 1936 treaties, also known as the “meat and beer treaty.” In the eve of World War 2, Franklin Roosevelt authorized 50\$ million dollars for construction works related to the defense of the canal, which generated the migration from rural Panamanians to the countryside to earn wages. The Canal Zone’s consumption drove the growth of the livestock industry in Panama’s interior, leading to accelerated deforestation in the rest of Panama. The spatial organization of the isthmus imposed by transitismo hinged on the one-dimensional transit sector and its heavily monopolized supporting activities, and this system was perpetuated by the establishment of the Canal Zone. Castro Herrera argues that “the presence of an ecologically sustainable enclave,” where technocrats foregrounded forest conservation and urban planning, “stimulated the tendency toward unsustainability that dominates the rest of Panama. Unsustainability ... has built an ever tighter circle around the enclave of

¹⁹³ Michael Donoghue, *Borderland on the Isthmus*, 24.

¹⁹⁴ More recently, the thirsty metropolis has started putting pressure and extracting resources from ecosystems increasingly farther away from the capital’s hinterland savannahs. This has resulted in the damming of rivers in other provinces and Indian *comarcas*, and the extraction of human and natural resources (rock and sand) from ‘interior’ regions destined for the ballooning transit region.

¹⁹⁵ Castro Herrera, *Pro Mundi Beneficio*, 146.

sustainability.”¹⁹⁶ Following the War, the cattle ranching footprint in Panama began to expand significantly. In 1952, 85% of the Panama Canal watershed was forested, a vital part of the assemblage making up the transit economy. Although estimates vary, by 1983 this ratio had descended to 30%.¹⁹⁷

The fact that the Panama Canal is a multiple lock canal built over a mountain range changed the waterway’s articulation with local water provision in qualitative ways.¹⁹⁸ Every ship’s lockage, during which water is lost to the oceans at a rate of 101,000 m³ per downward cycle, is a wasteful enterprise. In other words, about 52 million gallons of freshwater are lost during each ship’s transit. If current developments continue, the water supply will not suffice to provide for central Panama’s citizen needs and to fuel interoceanic transit. Increasingly uncertain precipitation patterns have raised doubts about the Canal watershed’s, effectively the Rio Chagres’s basin, ability to support an expanded lock infrastructure and growing population. The transit region continues to rely heavily on electricity generated at hydroelectric plants in the canal’s watershed. Ironically, the canal and the surrounding urban areas share the freshwater reserves stored in the watershed’s reservoirs. Heckadon argues that “Because economic growth in the basin has been both haphazard and unplanned,” and one should add ‘unequal,’ the deterioration of the Canal’s fragile, but immensely vital, watershed is almost inevitable. This process “threatens the very ability of the ecosystem to continue to

¹⁹⁶ Lindsay Poland, *Emperors in the Jungle*, 201.

¹⁹⁷ In the 1980’s, fears concerning Canal Watershed deforestation resulted in the adoption of the model of transboundary watershed authority developed in the Great Depression era Tennessee Valley Authority (T.V.A.). The TVA managed the Tennessee River watershed for navigation, flood control, power generation, and economic and social development; however, its model for that “bounded watershed... traveled to Europe, Asia, and Latin America.” The model came to Panama in the 1980’s, the same decade that saw the establishment of official national parks in the Chagres’s headwaters in an effort to protect the watershed forests and storage basins from *campesino* cutting. Carse, *Beyond the Big Ditch*, 50.

¹⁹⁸ It is worth noting that these figures only reflect the original Panama Canal lockages, and does not account for the additional functioning of the third set of locks, set to start operating in 2017.

produce and store fresh water in sufficient quantity and quality to meet the enormous demands that will be placed upon it.”¹⁹⁹

The canal’s planning and execution was carried ignoring the political, economic, human, and environmental realities that had existed in the transit area. Americans, more so than the French, saw in the isthmus, a tropical palimpsest for the application of revolutionary mechanical and energy advancements. This tabula rasa mentality was reminiscent of earlier treatment of native and imported labor, and reflected the attitudes toward tropical peoples forged by the currents of environmental determinism and scientific racism common during the New Imperialism period (c. 1880s – 1914). Retroactively, it is safe to assert, that the lock-based waterway’s design entailed transformations of such scale and impact that, according to Lindsay-Polland, “it is doubtful’ that the Canal would have been constructed under the current requirements of US environmental legislation.”²⁰⁰

In the Rio Grande valley, albeit to a lesser scale than in the Chagres’s, the environmental cost in ecological resilience and biodiversity was devastating. The Chagres river basin had been the home of independent communities of black and mestizo farmers that harkened back centuries. Although ever changing and affected by a plethora of variables, their lifestyles were better attuned to nature, dependent upon subsistence plus polycultures, employing variety of age-honed methods and crops, where small domestic plots were the main productive units. Unconnected to distant markets or foreign capital, local barter economies had functioned for centuries to provide non-local necessities. These populations were forcibly quarantined from the Zone, under racist

¹⁹⁹ Stanley Heckadon Moreno. “Impact of Development on the Panama Canal Environment,” 13.

²⁰⁰ Castro Herrera, *Isthmus in the World* (2008), 41.

notions of environmental determinism and medicine. Frenkel notes that, starting in the construction period and evident in planning documents, the I.C.C. “semantically (and later literally) depeopled the future Canal Zone, homogenizing it in their descriptions as a vast ‘jungle’.”²⁰¹ Cartographic representations of the Zone’s space played a major role in removing the forest peoples inhabiting the transit region from the technocratic and collective imaginary of U.S.²⁰²

²⁰¹ Stephen Frenkel, “Geographical Representations of the «Other»: The Landscape of the Panama Canal Zone,” *Journal of Historical Geography* 28, no. 1 (2002), 90.

²⁰² Lasso, “A Canal without a Zone.”

CONCLUSION

The results of this thesis support the study of *longue durée* environmental change based on ecological materialism proposed by environmental historians such as Jason Moore. The history of human-driven impacts on terrestrial ecosystems of the isthmus of Panama contains episodes of scattered throughout millennia. Nonetheless, the intensification of environmental change in the last five centuries reflects this global pattern of worsening rifts in social metabolism. Although certainly not a linear process, the importation of technologies, and accompanying cultures, developed in Europe and the North Temperate Zone resulted in the acceleration of environmental degradation starting with the Conquest. The development of an interoceanic corridor and the subsequent monopolization and industrialization of transisthmian transit reinforce Moore's thesis for understanding the reproduction and spatial properties of global resource frontiers.

There have existed competing routes for much of its history, but prior to paved highways and cars, the width of the isthmus rendered those routes unviable when compared to the one running through Central Panama. The isthmus' dependence on transit and its historic fetish by the elements of society that controlled its role in the world system had the biggest impact on Panamanian ecosystems of all other productive activities or ideals. The unique geography of this East-Central area would condemn it to depend on global trade patterns and economics to define its leitmotif. This mode of production – the facilitating of transit of goods, people, and capital across its strategic jurisdiction – was inherently disconnected from the soil and land, thus it was socially and

ecologically unsustainable. The recent expansion of the Panama Canal was conceived within a culture of nature that did not eschew the mechanistic and domination-driven attitudes toward non-human nature imposed by a century of U.S. control.

Besides Moore's model of world-ecology, the history of the Rio Grande illuminates some of the critical turning points in the water history of Panama's transit region and, in turn, sheds light on the problematic environmental history of transitismo as a mentality, one responsible for shaping modes of social and territorial organization and determining the country's collective relation to nature. The evolution of local environmental change, and attitudes toward nature, needs to be understood within a dialectical view of European expansion through resource frontiers whose landscapes constitute conditions as well as consequences of this expansion. Transitismo determined the nature of Panama's insertion into the emerging world market and ecological system during the sixteenth century, and proved to be the main driver of environmental change and resource use ever since. The transit-dependent mentality was chiefly responsible for the industrialization of the interoceanic route, and thus of the structural problems derived from it. Thus, as Castro Herrera argues, a history of the environmental impact of transitismo mentalities becomes, by definition, an environmental history of Panama.

Shortly after conjuring the independence of Panama and gaining sovereign rights over the Rio Grande's territory, the US Army Corps molded the Rio Grande to decant the water of the mighty Caribbean Rio Chagres into the Pacific. Rather than a big ditch, the Panama Canal is, as *Jaén Suárez notes*, a river that drains into two seas. In order to fulfill

the much prophesied goal of connecting the world's oceans, however, nature had to be transformed and harnessed to an unprecedented degree and scale. In the 1900s, pragmatic U.S. engineers decided upon a lock-based canal that relied on the natural watershed to provide freshwater for the functioning of the locks.

When the *Panama Canal Review* reported the disappearance of the Rio Grande following a sudden transformation of its upstream river bed, it had already been rendered an insignificant current. By 1955, not only was the waterscape transformed by relatively large reservoirs, but the valley itself had been refashioned by dredging and embankments. The environmental journalist offered a triumphalist view of the past glories of the river to legitimize and naturalize the position of the colonizers in the landscape. However, the fact that the journalist does not report the largest transgression on the river's integrity, its impoundment to create Miraflores Lake, reveals how dangerous can selective memories be when reconstructing socioecological processes, especially in imperial contexts.

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