TRANSPORTATION ENVIRONMENTS:
THE POLITICS, ECOLOGY, AND INFRASTRUCTURE OF THE PANAMA CANAL

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ABSTRACT

ASHLEY CARSE: Transportation Environments:
The Politics, Ecology, and Infrastructure of the Panama Canal
(Under the direction of Peter Redfield and Carole Crumley)

Many of us think of the Panama Canal as an excavated channel between the Atlantic Ocean and Pacific Ocean that was finished nearly a century ago. Open nearly any historical work on the canal and you will read about a monumental engineering project completed in 1914 by virtue of political will, technological innovation, and migrant labor. The protagonists of these accounts – typically politicians, engineers, and thousands of laborers – overcame significant obstacles and united the oceans, fulfilling a colonial dream of interoceanic transit and cementing a modern vision of global connection. I argue that this narrative, which might be called the "big ditch" story, is not inaccurate, but is too restrictive. This is to say that a focus on historical excavation elides the ongoing political, ecological, and infrastructural work across the region around the waterway that makes interoceanic transportation possible. My dissertation, which draws on ethnographic fieldwork and archival research conducted in Panama and the United States, reveals a constantly changing canal in which concrete and steel forms are bound up with water, soil, forests, and social life. This built environment is highly politicized, given shape through the diverse, sometimes oppositional projects that have been pursued by United States and Panamanian state institutions, capitalists, scientists, and people whose livelihoods depend directly on the land. The four main body chapters of the dissertation each examine a different aspect of changing political, ecological, and infrastructural relationships around the Panama Canal. Each chapter focuses on an object

(water, bananas, concrete, and forests) and a related theme (control/excess, governance/margins, politics/mobility, nature/infrastructure). Through these case studies, I develop an analytical framework that I call the political ecology of infrastructure.

To my parents, Lib and Jim, my brothers, Nick and Steve, and, of course, to Sara.

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I. INTRODUCTION

The Panama Canal is a critical international trade route and pathway for global commerce. Yet, despite the critical transportation services that the waterway provides, most accounts focus on the heroic tale of its construction.[1] Consequently, many of us imagine the Panama Canal as an excavated channel between the Atlantic and Pacific Oceans that was finished nearly a century ago. Open nearly any historical work on the canal and you will read of a monumental engineering project completed in 1914 by virtue of American political will, technological innovation, and migrant labor. The protagonists of these accounts – politicians, engineers, and thousands of laborers – overcame obstacles and united the oceans, fulfilling an old colonial dream of interoceanic transit and a modern vision of global connection. This narrative – let's call it the "big ditch" story – is not inaccurate, but it is too restrictive in spatial, temporal, and ecological terms.

My dissertation reveals a different Panama Canal: a work in progress where concrete and steel forms are bound up with water, soil, and forests. This carefully managed environment is also politicized, given shape through the diverse, sometimes oppositional projects pursued by US and Panamanian state institutions, capitalists,

[1]The public's continued fascination with the construction of the Panama Canal is illustrated by the significant attention received by Julie Greene's *The Canal Builders* (2009) and Matthew Parker's *Panama Fever: The Battle to Build the Canal* (2007, both reviewed widely in the English-language media.

scientists, and smallholder agriculturalists. The dissertation, a historical ethnography of canal landscapes, is a work of environmental anthropology in dialogue with human geography, environmental history, and science and technology studies. I draw on data collected through ethnographic research in Panama and archival research in the US and Panama to examine how diverse groups have lived, worked, and made sense of this built environment. Therefore, the dissertation is largely narrated by people who have known these landscapes most intimately – *campesino* farmers, state functionaries, and natural scientists, to name a few – and also by people who have acted upon them at a distance.

As my emphasis on infrastructure and ecology suggests, the protagonists here are not exclusively human. This move reflects the environmental tradition in anthropology, engages a recent ontological turn in social theory,[2] and reflects my research findings. In interviews and archival documents, people consistently describe canal landscapes in active terms: that is, as ecologies with the potential to exceed human control. Through a political-ecological and infrastructural analysis of the relationships between the Panama Canal and its hinterlands, my research explores the organization of transportation environments in general and examines what everyday life is like for people living at the margins of large technical systems. Three main questions have guided my research and writing: 1) What projects of technical, political, and ecological reorganization have been implemented at a regional scale to facilitate transportation across Panama? 2) What new connections between humans and environments in Panama have been enabled through transportation infrastructure? 3) What existing connections have been disrupted?

[2]Escobar 2007.

WHY IS THE PANAMA CANAL ANTHROPOLOGICAL?

The Panama Canal seems, at first, like strange ground for anthropology: too large, too technical, and insufficiently human. But the themes that run through the dissertation – environment, technology, and development – have been persistent, if unstable, anthropological concerns. As an object, then, the canal allows us to reflect on the changing theoretical relationships among these themes in the discipline. Consider, for example, the research programs of mid-to-late-twentieth century cultural ecology and ecological anthropology. Inspired by and writing against the legacy of Julian Steward, these scientific anthropologies focused on subsistence systems in small, rural, and often indigenous communities in the pursuit of generalizable rules about how societies adapt to their environments. Steward's cultural ecology posited a relationship between the environment, exploitative technology, and the forms of social organization necessary to bring technologies to bear on the environment. More specifically, the social organization of labor (the "cultural core"), shaped by available technologies, was understood to be the axis on which the nature-culture relationship turned.[3] For example, Steward argued that the Western Shoshone were distributed across the landscape in clusters of nuclear families because they occupied a resource-poor environment, their exploitative technology "was of the simplest sort known" (bows, digging sticks, stone-flake knives, etc.), and their labor was organized around hunting and gathering. The group's cultural features and social organization were considered adaptations to exploitable resources.[4]

The heuristic utility of cultural-ecological models held so long as the scale of

[3]The first step in Stewardian cultural ecology was to analyze "the interrelationship of exploitative or productive technology and environment." (1955, 41).

[4]Murphy 1977, 23-24; Steward 1970.

research and analysis could be reconciled with the economic geography of an actually existing community. Cultural ecologists perceived the nature-culture relationship to become diffuse and less amenable to scientific inquiry as subsistence economies became more connected with extra-local markets in terms of anthropological understanding, actual commercial activity, or both. Steward hypothesized that the adaptive effect of environment on culture would decrease in proportion to social complexity and control of the environment through technology. He wrote, "It makes a great deal of difference whether a community consists of hunters and gatherers who subsist independently by their own efforts or whether it is an outpost of a wealthy nation, which exploits local mineral wealth and is sustained by railroads, ships, or airplanes. In advanced societies, the nature of the culture core will be determined by a complex technology and by productive arrangements which themselves have a long cultural history."[5]

Steward wrote those lines a half-century after the US government began work on the Panama Canal in 1904, marking the beginning of a decade-long construction project described at the time as modern man's ultimate triumph over nature.[6] The US Canal Zone, a transportation enclave forcefully established by a wealthy nation across a newly sovereign Central American republic,[7] was emblematic of an expanding network of modern transportation technologies that created anthropogenic, or second, nature.[8] In

[5]Steward 1955, 39.

[6]There are many popular triumphalist accounts of Panama Canal construction. Some exemplary titles include: Our Canal in Panama: The Greatest Achievement in the World's History (Allen 1913) and America's Triumph at Panama (Avery 1913).

[7]Panama became independent from Colombia in 1903 with the tacit support of the US government. One good historical work on the subject is LaFeber 1978.

[8]The distinction of first nature (pre-human) and second nature (anthropogenic) comes from Hegel and Marx (Schmidt 1971, 42-43 and Smith 1984, 19). However, as Cronon points out, the distinction becomes ambiguous once when we realize that nature is a mingling of non-human and human agency (1991, xix).

Panama, the pursuit of transportation was a technical, environmental, and territorial project. The Panamanian state granted the US "use, occupation, and control" of the ten-mile-wide strip of territory later known as the Canal Zone in the Panama Canal Treaty of 1903. In Panama and elsewhere, new socio-ecological forms accreted along expanding networks of railroads, roads, and canals,[9] giving rise to the cultural hybridization that North American anthropology at that time defined itself against as it sought to salvage or document "real" native cultures.[10] The Panama Canal, then, was an anti-anthropological project insomuch as it was understood to link economies and erase cultural difference.

From the perspective of twenty-first century anthropology, it is easy to criticize the bounded subsistence systems of cultural ecology as the byproduct of a selective vision or willful reduction, rather than accurate representations of historical communities. We know that the "pristine" cultures studied by early anthropologists were shaped through interactions with global political economies.[11] If culture is less stable and recognizable than it once appeared, so, it would seem, is nature. Anthropological approaches to "the environment" have fragmented as the perceived stability of a unitary nature has been questioned. On the one hand, post-structural critics in the social sciences and humanities have argued that nature, wilderness, and environment are historical-cultural constructs.[12] On the other hand, natural scientists have called for a "new ecology" emphasizing non- or multi-equilibrium conditions, non-linearity, interactions

[9]See, e.g., Cronon's (1991) environmental-historical analysis of Chicago via the transportation networks that linked it to hinterlands in the upper Midwest of the US and to east coast markets.

[10]See, e.g., Kent Lightfoot's (2005) discussion of cultural encounters in the missions of California and the perception of "legitimate" Indians among anthropologists.

[11]Wolf 1982.

[12]The 1995 exchange between Cronon and Soule highlights the tensions and stakes in what might be described as the construction of nature debates.

among discontinuous spatio-temporal scales, and increased consideration of human political, social, and economic systems.[13]

Even as theorists interrogate nature from different philosophical, theoretical, and political positions, few dispute that significant material changes have taken place around us. Beginning with the environmental movement of the 1960s and 1970s, scholars, activists, politicians, and others argued that development and modernization had gone awry. Rather than emancipating humans from environmental constraints, as Steward had hypothesized, environmentalists argued that modern technologies bound a global population more tightly and precariously to what seemed to be a shrinking planet.[14] By 1973, Clifford Geertz had abandoned cultural ecology for the open frontiers of interpretive anthropology. His inversion of Steward's development narrative that year anticipated important shifts in anthropological and environmental thought:

> It used to be thought that, although environment might shape human life at primitive levels, where men were, it was said, more dependent on nature, culture-evolutionary advance, especially technical advances, consisted of a progressive freeing of man from such conditioning. But the ecological crisis has divested us all of that illusion; indeed, it may be that advanced technology ties us in even more closely with the habitat we both make and inhabit, that having more impact upon it we in turn cause it to have more impact upon us.[15]

Geertz's claim that technology binds us more closely to an environment of our own making resonates with contemporary problems and anthropologies. Today, some observers define breakdown as the "new normal," forecasting an endless future of enviro-techno-political disasters like floods, famines, and oil spills. Geertz speaks of humans

[13]Fiedler et al. 2001, Holling 1973, Gunderson and Holling 2002, Scoones 1999, Zimmerer 1994,

[14]Perhaps the key work in modern Malthusian environmental discourse is Ehrlich 1968.

[15]Geertz 1973, quoted in Dove and Carpenter 2010, 19.

collectively, but some of "us" are tied more closely to the environment than others. The effects of disasters are not borne evenly. As people in the most vulnerable and rapidly changing areas struggle to live with new environments, anthropologists and others are working to devise appropriate ways of theorizing, studying, and acting. I have juxtaposed Steward's cultural ecology and the infrastructural ecology exemplified by the canal in order to locate the major themes of my research – environment, technology, and development – within the genealogy of "environmental anthropology"[16] and introduce three analytic problems – scale, boundaries, and politics – that have troubled this subfield and pushed it forward. I will return to these three problems throughout the introduction.

Anthropologists need more sophisticated analytical tools for thinking about technology, nature, and culture for a new set of circumstances. Steward's emphasis on technology and labor as mediators of nature-culture relationships is a good starting point if they are reconceptualized as relational, political, and historical materials – that is, as I explain below, in terms of infrastructure. My theoretical objective in the dissertation is to develop a *political ecology of infrastructure* through the case of the Panama Canal. Bringing technology back into environmental anthropology via infrastructure turns our attention to technology as an integrated part of complex human-environmental systems.

The remainder of the introduction is organized as follows: First, I explain how I came to conduct research in Panama and frame the dissertation project as I have. Second, I discuss the past and present of the transport economy in Panama and describe

[16]I put environmental anthropology between quotation marks to flag that there was no subfield identified with that name before the 1990s. I want to clarify that I am constructing a particular genealogy of environmental anthropology here, but will not use quotation marks hereafter.

the two communities where I conducted field research. I describe my field site selection process, methodology, and community engagement. Third, I introduce the bodies of literature that underpin this work – infrastructure studies and political ecology – and lay out an analytic framework through a discussion of points of intersection between the two. Fourth, I map the organization of the dissertation and summarize the four body chapters.

FROM FORESTS TO INFRASTRUCTURE (THE MACHETE AND THE FREIGHTER)

My dissertation project emerged from preliminary research on forest politics in Panama. I arrived in Panama City in June 2006 with an invitation to collaborate with an interdisciplinary team of natural and social scientists working at the Smithsonian Tropical Research Institute on the PRORENA project (project for reforestation with native tree species). My research focus at the time was the relationships among environmental management, policy, and rural land use. I knew little about the canal and considered dams, locks, and ships too "big" for anthropological research. My work with PRORENA, which was limited to that summer, was to focus on the political, economic, and social context of deforestation around the Panama Canal. It was thematically related with my previous research on perceptions of and conflicts around forests plantations in the Ecuadorian Andes, but the "context" was quite different. The environmental issues that interested me were, it turned out, also infrastructural issues.

Fresh water is vital to the operation of the canal. Fifty-two million gallons of managed water from the surrounding drainage basin, or Panama Canal watershed, flow through a lock system and into the Atlantic and Pacific Oceans with each passing ship (Chapter 1). The watershed is arguably the focal region for environmental management

in Panama today. But this is a relatively recent development. Over the past thirty-five years, canal administrators, politicians, scientists, and media outlets have discursively constructed the problem of deforestation within the watershed in such a manner that rural ranchers and farmers – largely swidden agriculturalists – are scripted as the key actors behind a problem actually produced through the actions of multiple actors in Panama and beyond[17] (Chapter 4). Explanations have taken two forms since the 1970s. At first, policymakers characterized farmers as irrational, environmentally-destructive actors. In response to this framing and a changing intellectual climate, more sophisticated social science analyses have situated land use decisions within a multi-scale political, economic, and social context.[18] What is obscured in both formulations, I later realized, is the critical role of water management and transportation technologies in formatting relationships between farmers and forests in Panama and networks of global producers and consumers.

Put simply, forest politics around the canal cannot be understood without attention to the ecology of large technical systems. International development organizations, conservation organizations, and the US and Panamanian states have channeled millions of dollars into watershed research, management, and development because forests are understood to regulate the flow of water into the network of streams, rivers, artificial reservoirs, and locks that makes transportation across Panama possible. Attention to infrastructural relationships reveals that the canal's water scarcity issues are not absolute, but defined through the relationship between traffic and the specific demands of the lock

[17]Myths about the inherent environmental destructiveness of swidden agriculture, as Michael Dove (1983), points out, have often been used to facilitate the extension of state administration into new territories.

[18]See the work of Stanley Heckadon-Moreno (1984, 1985). He argues that if the farmer is the principal actor in forest destruction, he should not be considered the major guilty party. Agricultural modernization through low-interest loans, technical assistance, good roads, and institutional support pushed deforestation.

system. More ships require more water, which means that administrators and engineers must search for new ways of regulating and storing the flow of watershed rivers.

Technology and environmental politics are inextricably connected around the Panama Canal. Reflecting on the rise of the watershed as a new administrative region during the 1980s, Panamanian anthropologist Stanley Heckadon-Moreno wrote: "In essence, the government decided that, in order to save the Canal, the forests had to be protected from the machetes of the farmers."[19] Protect the canal from machetes? How could such a simple, "local" technology threaten a modern, "global" commercial trade route? How do we reconcile this surprising conjuncture with the hierarchical assumptions that have long been embedded in anthropological thinking about technology and the environment? After all, for nineteenth century anthropologists like Henry Louis Morgan, technologies like the farmer's machete and the canal's freighter signaled distinct stages along what was understood to be a ladder or hierarchy of cultural development. Later, Julian Steward and Leslie White translated and applied Marx's historical materialism to subsistence societies at the margins of capitalism. These groups' extractive technologies were understood to mediate between the spheres of nature and culture. White, in particular, was reportedly fond of citing Marx's statement that a hand axe creates one kind of society and the steam mill another.[20] Today, this distinction is untenable. Technologies cross-cut and redraw cultural and environmental boundaries.

A key challenge facing contemporary environmental anthropology, then, is to

[19]Heckadon-Moreno 1993, 138.

[20]Sahlins 2010, 374-375.

locate the hand axe and the steam mill – or, in the case of the Panama Canal, the machete and the freighter – within the same analytical frame. Anthropologists have increasingly embraced multi-sited research.[21] Ethnographies of global connection, to use Anna Tsing's phrase,[22] are the order of the day. These efforts have led to important insights, but also raised difficult questions. How do we take cultural and ecological difference seriously while also recognizing the importance of connection? How do we theorize relationships that are irreducibly ecological, cultural, economic, political, technical, *ad finitum*, without writing about everything at once? How do we move beyond the vague space of assemblage to the particularities and potentialities of form, organization, and design? I propose the political ecology of infrastructure as a framework for navigating the ecology that binds and differentiates the ecologies of the machete and the freighter.

PANAMA, THE TRANSPORT ECONOMY, AND ETHNOGRAPHIC FIELD SITES

Panama occupies an isthmus connecting North and South America and dividing the Atlantic and Pacific Oceans. The nation has a land area of approximately 29,000 square miles, just less than the US state of South Carolina.[23] The canal is oriented northwest-to-southeast and bisects mountains that run east-west along the spine of the isthmus. These mountains, the *cordillera central*, are flanked by upland plains that descend to rolling hills and coastal plains. The coastal plains are the country's best agricultural land, but 75% of an estimated 3.5 million inhabitants live in urban areas, particularly Panama City (population: ~1.4 million), which is located at the waterway's

[21]See Marcus 1995 on multi-sited ethnography and ethnography of the world system. See Gupta and Ferguson 1997 for a seminal challenge to understanding culture in terms of a spatially localized group of people and call to situate the local within transnational spaces.

[22]Tsing 2005.

[23]CIA World Factbook 2011.

Pacific terminus, and its sprawling metropolitan area, including large bedroom communities.[24] Development also stretches along the canal to the Atlantic city of Colon (population: ~50,000).

Figure 1.1: Map of Panama and the study area (Google Maps).

Panama has achieved stellar rates of economic growth in recent years. The national economy expanded at a rate of 8% annually between 2005 and 2010, the fastest rate in the Americas.[25] Economic growth was driven by a robust service sector. In 2010, the estimated gross domestic product by sector was: 77.6% service, 16.6% industry, and 5.8% agriculture.[26] The direct revenues generated by the canal, which is administered by an autonomous state agency called the Panama Canal Authority were 7.5% of gross domestic product ($2 billion) in 2010.[27] However, the canal's overall economic impact is

[24]CIA World Factbook 2011.

[25]The Economist 2011. 39.

[26]The Economist 2011. 39.

[27]The Economist 2011, 39.

certainly larger. Pro-business governments have established a favorable tax and investment environment – including one of the lowest levels of import tariffs in Latin America – that has encouraged the expansion of the Colon free-trade zone and the expansion of insurance, finance, and legal industries. The state's focus on the development of service sector institutions and infrastructure over other sectors has benefited some groups of people more than others.

The Economist magazine recently compared Panama with another rising tropical transportation hub, Singapore, and pointed out a key difference between the nations. While Singapore's economic growth has been built upon high productivity – associated with investment in education – Panama's growth has come from the accumulation of capital in the form of infrastructure. Panama committed $5.3 billion to expand the canal (a project begun in 2007 and slated for completion in 2014) and another $13.6 billion for domestic infrastructural development. The government also spends money on education, but with comparatively poor results. Panama recently placed sixty-third out of sixty-five economies on the PISA study, a test of fifteen-year-olds. Singapore placed fourth. Unsurprisingly, potential investors perceive Panama to have a shortage of skilled labor and oversupply of unskilled labor.[28] Transportation generates economic growth at a national scale, but employs only six percent of the population vs. the twenty-five percent employed in agriculture.[29] Moreover, Panama ranked third in income inequality in Latin America – just behind Colombia, Bolivia, and Honduras.[30]

[28]CIA World Factbook 2011.

[29]Barry and Lindsay-Poland 1995, 72-73.

[30]This ranking is based on Gini coefficient calculations published in the 2010 UN Human Development Index. The Gini coefficient – a measure of the "deviation of the distribution of income (or consumption) among individuals or households within a country from a perfectly equal distribution" – is used because,

The uneven distribution of the economic benefits of transportation is a historical problem in Panama. Interoceanic transportation has dominated the economy around the Chagres River since the sixteenth century. Between 1550 and 1750, the isthmus was a critical passage point for Spanish gold extracted from western South America and shipped back to Spain.[31] Panamanian historian Alfredo Castillero Calvo characterizes the long-running relationship between Panama and the world system as *transportismo*. He argues that Panama is distinct from other Latin American countries because its economy has been dedicated to transportation rather than natural resource extraction or monoculture agriculture.[32] This orientation has meant that populations and political-economic institutions have been spatially concentrated within the transit zone and that the regional economy has been marked by episodic cycles of boom and bust linked to outside events. Another effect has been an entrenched oligarchy of a white, urban merchant class with ties to foreign investment and trade. This situation was unusual in Latin America, where most countries were dominated by a landowning elite during this period.[33]

Boosters of the transport economy have promised, but rarely delivered, widespread benefits. Since the Spanish colonial system of *ferias y galeones* (trade fairs

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unlike calculations based on the gap between mean and median income, it accounts for income concentrated at different points in the distribution (United Nations Development Program 2010, 224).

[31]Castillero Calvo 1984.

[32]Castillero Calvo 1973.

[33]Panamanian historians have struggled with issues of sovereignty and nationalism, particularly defining a national past prior to and independent of the construction of the US canal during the early-twentieth century and associated independence of 1903. For a discussion of this, see Szok 2001. See Gandasegui 1967, Hughes and Quintero 1987, and Porras 1953 for historical discussions of the oligarchy in relation to other classes or social groups. See Soler 1985[1963] and Navarro 1982 on Panamanian liberalism and nationalism.

and galleon ships), a few groups in Panama – the commercial class, storehouse owners, and transport service providers – have disproportionately benefited from the construction and institutionalization of transportation systems. This process was repeated during other eras.[34] Castillero Calvo writes about the persistence of *transportismo* in the wake of yet another unprecedented expansion of the Panamanian economy in the 1950s and 1960s, a period also marked by increased landlessness and rural-urban migration. Drawing on dependency theory and world system theory,[35] he argues that a key node of world trade was dangerously dependent on insecure global markets to meet internal needs for food and manufactured goods. I sketch this history to situate my contemporary research.

My ethnographic research in Panama focuses on historical experience and everyday life in two rural communities near the canal. I selected the communities in order to understand different moments in regional history and relationships with canal administrators. The first community, Limon, is situated on the east bank of Gatun Lake, the massive artificial reservoir that stores water for canal use. The second, Boquerón, is located on a tributary of the Chagres River in the mountainous headwaters of the canal.

Limon has approximately six hundred residents.[36] Many of the older members of this largely Afro-Panamanian population describe themselves as descendants of laborers who worked on the Panama Railroad (1850-1855), the French canal project (1881-1889), or US canal project (1904-1914). Like many artificial reservoirs, the creation of Gatun

[34]McGuinness (2008) has made a similar argument about the spatially and temporally uneven benefits of transportation in his analysis of the effects of the mid-nineteenth century California gold rush in Panama.

[35]Cardoso 1979, Frank 1969, Prebisch 1972, Wallerstein 1974.

[36]Government of Panama 2000. The 2000 census counted 164 households and 574 residents in Limon, an increase from the 106 households and 533 residents recorded in the 1980 census.

Lake led to widespread human displacement. In preparation for the flooding, US administrators relocated what they called "native communities," typically inhabited by West Indians, Hispanic *mestizos*, Chinese, and Europeans, to lands above the level of the future lake. The history of Limon is therefore closely tied to the lake, its islands, and the forgotten alluvial landscapes below its surface (Chapter 1). According to oral history, the economy of the lake region was dominated by the export banana trade and subsistence agriculture before the Second World War (Chapter 2). After the war, it became common for community members – especially men – to work as laborers in the US Canal Zone, but they continued to cultivate small farms. The relationship between this community and canal administrators – at first North Americans and, today, elite Panamanians – is complicated. From a hill above town, one can see cargo ships passing through the lake with goods, commodities, and people bound for other places. Yet, in the community's collective memory, the best times were not transportation booms, but agricultural booms.

Boqueron had 130 residents in the 2000 census, making it even smaller than Limon. The community was settled in the late-1950s by landless *campesino* farmers, largely from Panama's rural interior – people with less direct historical connection to transportation projects. The population increased through the 1960s and into the 1970s, when the community became the site of an *asentamiento*, a politically contentious state project that promoted rural colonization, cooperative economic development, and public service delivery.[37] The physical nucleus of the community is a primary school, a public health clinic, a communal house, and two churches, one evangelical and one Catholic, but the houses stretch for miles along a gravel road that runs parallel to the Boqueron River

[37]Hernandez et al., 1986.

(Chapter 3). What makes Boqueron particularly interesting in terms of expanding canal infrastructure is that it became an important site of contestation between rural people and canal administrators as the community was enclosed within the new Chagres National Park in the 1980s and the forests around it – which local people farmed – were legally incorporated into the canal's water management network (Chapter 4). Today, Boqueron and neighboring communities are popular sites for sustainable development projects.

I lived in the two communities and Panama City for fourteen months while conducting ethnographic research. Drawing on training in qualitative methods and previous fieldwork experience, I completed over seventy semi-structured oral history interviews focused on interviewees' experiences with social, economic and environmental change. The data that I collected through community-based fieldwork provides a fine-grained understanding of the changing contours of everyday life around the canal and highlights changing relationships among state agents, rural peoples, the land, and infrastructure. I repatriated the narratives collected to the two communities by writing collaborative local history documents and then facilitating community history workshops, both in Spanish, during April and May 2009. Second, I conducted eight months of archival research in Panama City and the US. At the Panama National Library, I collected thousands of pages of state ministry reports related to environmental management and development (agriculture, public works, natural resource management, sanitation, etc.) and newspaper articles about pertinent historical events. At smaller archives across the city, I collected relevant correspondence, which provided a more intimate understanding of the changing relationship between Panamanian state

institutions and the environment.[38] The data that I collected through Panamanian archival work demonstrates changing state plans for rural lands and citizens around the canal and the specificities of the projects through which those visions were enacted. I also worked at the National Archives II in Maryland. The official Panama Canal correspondence that I collected at this facility provides a detailed picture of changing US state plans for the rural areas of the Canal Zone, the human and environmental categories used within canal institutions, and connections with transnational expert networks. Finally, I conducted two months of institutional ethnography in Panama. The objective of this phase was to do semi-structured interviews with environmental professionals who worked in rural areas around the canal in order to link community-based research and archival materials.

THE POLITICAL ECOLOGY OF INFRASTRUCTURE

Through the analytical framework of the political ecology of infrastructure, I strive to build upon political ecology's persistent focus on the human-environmental consequences of political-economic power relations and more recent concern with discourse by highlighting the role of infrastructures in organizing, but not determining, contemporary ecologies. As scholars of science and technology have shown, the study of large technical systems – networks of pipes, cables, roads, and canals – illuminates the lines of connection (and spaces of disconnection) that often format the resource access and distribution problems at the core of political ecology research.[39] Where does water (not) run? Where are roads (not) built? Where does electricity (not) work? Thinking in terms of infrastructure reminds us that individual technologies, or artifacts, are

[38]Panama Canal Authority Technical Resources Center, ANAM Library (Panamanian National Environmental Agency), and the Belisario Porras Archive at the library of the University of Panama.

[39]Edwards 2003, Star 1999, Winner 1986.

components of larger systems woven into the modern social and political fabric. These systems materially inscribe human politics on the landscape in a manner that facilitates the movement and livelihoods of some communities and restricts those of others.

Infrastructures channel flows of people, goods, and information, establishing new spatial forms that are different from the political geography of the nation-state, even if they continue to be shaped by the state.[40] These connective tissues shape and transcend individual experience. They format circulation across great distances, but are also vital sites for the organization of everyday life. These are only a few of the ways in which infrastructure helps us to reconceptualize three key themes that I have identified in political ecology: scale, politics, and boundaries. My objective below is to highlight absences and contributions useful for developing a political ecology of infrastructure. I follow the genealogies with a brief summary of how I combine the literatures.

Political Ecology: Scale, Boundaries, and Politics

No unbroken line runs from early anthropological research of cultures and environments to contemporary political ecologies. The anthropological traditions that influenced early political ecology (culture areas, cultural ecology, and ecological anthropology) were transformed through encounters with more radical scholarship (world systems theory, radical peasant studies, dependency theory, and post-structuralism, to name a few). My goal is to point out the continuities and discontinuities between political ecology and older environmental anthropologies, particularly around the problems of scale, boundaries, and politics. Again, these are the problems that we might

[40]Barry 2006.

better navigate by conceptualizing technology in terms of infrastructure. They also provide the theoretical background to situate why I have studied and written about the Panama Canal as I have.

Political ecology was forged during the political and theoretical upheavals of the 1970s and 1980s when scholars conducting research in the rural, Global South questioned the validity of the bounded human-environmental system.[41] It was, at first, a conscientious effort by anthropologists and geographers to attend to problems of scale and politics in explanations of environmental degradation. One of the field's early analytical innovations was to situate local human-environment interactions within nested scales of political, economic, and social power. However, both the system boundaries that early political ecologists critiqued and the multi-scale framework they proposed were both built upon the Western philosophical dualisms of subject-object, ideal-material, and – of particular importance for political ecologists – nature-culture.[42] In this section, I highlight understandings of the nature-culture boundary in the environmental anthropologies prior to political ecology because ideas about the character of this relationship still shape pivotal theoretical debates. Early political ecologists sought to explain environmental degradation, but, for early-twentieth century anthropologists, the "environmental problem" was different. They wanted to understand culture, not nature.

The study of culture areas, formalized in work by Alfred Kroeber (1939) and

[41]Important transitional works between cultural ecology and political ecology include: Nietschmann 1973, Watts 1983, and Wolf 1972.

[42]See Latour 1994 for an influential argument about how the purification of nature-culture led to the proliferation of hybrid forms. For influential non-dualist philosophies, see especially the work of Spinoza, the American pragmatists (e.g., Dewey, James, Pearce, Whitehead), Nietzsche, Foucault, and Deleuze.

Clark Wissler (1927), illustrates the tension between historical (diachronic) and environmental (synchronic) approaches to understanding culture. I introduce political ecology via the idea of culture areas because the key problematic – the spatio-temporal distribution of culture – has persisted, even as research orientations and programs have changed. Culture areas were spatial abstractions of the distribution of cultural features (technology, political systems, magic, religion, etc.) across human groups. Kroeber, Wissler, and others identified a correlation between patterns of cultural and natural features, a finding that raised questions of human adaptation to the environment that were politically troubling given the socio-political context of environmental determinism.[43] Under the banner of Boasian historical particularism, most North American cultural anthropologists understood cultural development in terms of historical diffusion, not the environment. Kroeber, Franz Boas's student, concluded, "cultures are rooted in nature…[but] no more produced by that nature than a plant is produced or caused by the soil in which it is rooted. The immediate causes of cultural phenomena are other cultural phenomena."[44] By isolating culture from nature and demarcating history and evolution, Kroeber not only blocked environmental determinist interpretations of culture areas data, but also the opposite interpretation: that indigenous people had played an active, if not determinant, role in shaping their environments.[45] Moreover, there was a politics to what could be said about people and the environment, even if politics were not part of the analysis, per se.

[43]See Gould 1996 for a discussion of anthropological science, race, and environmental determinism.

[44]Kroeber 1939, 1.

[45]There are large historical and archaeological literatures on pre-contact landscape modification by indigenous peoples in the Americas. See, e.g., Denevan 1983 and Mann 2006. The case of anthropogenic fire is illustrative example of how landscapes were produced at the intersection of human agency, technologies, climates, and biotas. Most of the planet's terrestrial biotas, according to environmental historian Stephen Pyne (1998), were adapted to anthropogenic fire.

Julian Steward, one of Kroeber's students, wanted to move beyond correlation to *explain* the origins of the cultural patterns in relation to the natural world.[46] Steward and the generation of anthropologists he influenced studied the interrelationship of environment, technology, cultural features, and behavior patterns.[47] For him, the nature-culture relationship was dialectical and mediated by the social organization of labor and exploitative technology – or the cultural core.[48] But, like culture areas, cultural ecology was dualistic. Steward believed that the environment had a creative role in human affairs, but he was not an ecologist. Like Kroeber and Wissler, he was interested in explaining cultural features. So, the scale of analysis was coterminous with the perceived boundaries of a particular human group's subsistence system. A new generation of ecological anthropologists argued that cultural ecology lacked ecology.[49] By privileging the scale of human subsistence, they argued, cultural ecologists cut off webs of relationships with non-human organisms and other human groups. Ecological anthropologists borrowed concepts from the natural sciences – equilibrium, feedback, niche, etc. – to locate humans within the ecosystem.

The shift from cultural ecology to ecological anthropology during the 1960s and 1970s illustrates the manner in which the scale and politics of research were bound up with philosophical assumptions. Ecological anthropology took steps toward dissolving the nature-culture boundary in favor of webs of mutual causality – ecosystems with

[46]Steward 1955, 36.

[47]Steward 1955, 40-41.

[48]Steward 1955, Murphy 1977.

[49]See, e.g., Vayda and Rappaport 1968.

people in them.[50] However, if borrowing from the natural sciences stimulated new insights, it also encouraged new forms of biological reductionism. Concepts developed to describe the behavior of non-human populations were applied, often crudely, to complex human culture, history, and politics.[51] At their most functionalist, ecological anthropologists reduced cultural factors to adaptive significance. They also continued to focus on localized adaptations to specific ecosystems. They included non-humans in their analyses, but did not account for extra-local political-economies and technologies.

As I mentioned, political ecology – in its earliest, Marxian formation – emerged as an effort to deal with these problems of scale and politics. Since then, major theoretical contributions have included the development of new analytical frameworks – nested scales, networks, and assemblages – for human-environmental research. These frameworks have allowed scholars to critique hegemonic environmental narratives, particularly the widespread belief that environmental degradation in the Global South is driven by population growth and rural ignorance.[52] In a seminal work, Piers Blaikie and Harold Brookfield write that local environmental degradation took place within the context of multi-scale, core-periphery relationships: "The complexity of these relationships demands an approach which can encompass interactive effects, the contribution of different geographical scales and hierarchies of socioeconomic organizations (e.g. person, household, village, region, state, world) and the contradictions between social and environmental changes through time."[53] For many scholars, however,

[50]Barth 1956, Geertz 1969, Rappaport 1968, Vayda 1974.

[51]Dove 2001, 2006, Watts 1983, 234-239.

[52]See, e.g., the revisionist political ecologies of Fairhead and Leach 1996, Hecht and Cockburn 1989.

[53]Blaike and Brookfield 1987, 17.

the theoretical and political problem with this approach was that it assigned capitalism a totalizing power and assumed a structured, hierarchical relationship among nested scales.[54] The rural land manager was acted upon from above and denied agency.[55]

Consider, again, the case of the farmer's machete as a threat to the Panama Canal within this framework. It sits awkwardly among the nested scales. Which actor, scale, or level can be said to control the relationship? In this case, ranked structure does not seem to reflect the multi-directional, indeterminate character of the relevant power relationships. The relationships between the transnational socio-technical networks assembled to move a freighter and the trans-local networks that support rural agriculture are clearly asymmetrical. Panama Canal administrators and state institutions can mobilize resources to forcefully relocate farmers or enact projects to control their behavior, but farmers are so distributed and the significance of each action so minor, that such projects are, at best, limited by logistical constrains. Power, it seems, is neither here nor there, but distributed. Where early political ecological chains of explanation render the "local" an outcome of regional-global processes, infrastructure suggests heterarchical political relations, meaning that power relations change with circumstances.[56] I develop this alternative approach to political ecology below, arguing that linkages like this illustrate how power is distributed through relationships, including those built into the environment as infrastructure, rather than affixed to a given hierarchical organization.[57]

[54]See review essays of the subfield's emergence in Biersack 2006, Peet and Watts 2004, Robbins 2005.

[55]This was a political-ecological microcosm of the larger structure-agency debates taking place at the time.

[56]Crumley 1987a, 1995, 2005, Kontopoulos 1993, McCulloch 1945.

[57]See Deleuze's reading of Foucault's microphysics of power (1988, 25-44).

Even as Marxian political ecology held sway, concerns about reflexivity and discourse were ascendant in anthropology, influenced by broader trends in social theory, especially literary theory.[58] The post-structuralist turn in political ecology, often linked with the 1990s work of Arturo Escobar, drew on Foucault and emphasized the discursive construction of nature.[59] The proponents of this "second-generation" political ecology engaged epistemological debates around constructivism and anti-essentialism.[60] The environment was understood to be constituted through language, particularly the discourses of modernist forms of knowledge like ecology and politically economy. What is important to point out here is that, although (first-generation) Marxian and (second-generation) post-structural political ecologies took distinct epistemological and political stances, they share a dualist philosophy in which one sphere (nature) was understood to be shaped by – or even collapsed into – the other (culture). This dichotomy was further reified through polarizing conceptual and methodological debates concerning the accuracy and politics of privileging one sphere or the other. Some scholars called for more attention to politics (culture) and others to ecology (nature).[61]

Post-structuralist political ecologists emphasized other ways of knowing and acting vis-à-vis nature as a viable political alternative to dominant frameworks, particularly knowledge produced by social movements and indigenous peoples.[62] The emphasis on discourse opened up new ways of understanding politics and important lines

[58]Clifford and Marcus 1986, Clifford 1988.

[59]Escobar 1996, 1998.

[60]Escobar 2010, 91.

[61]Paulson, et al. 2003, Vayda and Walters 1999, Walker 2005.

[62]Escobar 1998.

of research,[63] but, like neo-Marxists, post-structuralists often assigned little agency to the non-human world. This is to say that it was known, constructed, contested, commodified, and constituted by humans, but rarely conceptualized as active or creative. Timothy Mitchell addresses this problem in an essay entitled "Can the mosquito speak?," arguing that an emphasis on discourse can be politically limiting:

> This kind of analysis leaves the world itself intact. Intentionally or not, it depends upon maintaining the absolute differences between representations and the world they represent, social constructions, and the reality they construct. It is an analysis that leaves the economists to carry on undisturbed, pointing out that they are not concerned with the history of representations, but with the underlying reality their models represent.[64]

Post-structuralism struggled, in other words, with an incapacity to make strong truth claims about a reality that included, but was irreducible to, discourse. [65] Finding a way out of this philosophical and political challenge has been a key concern in more recent political ecology. In a 2010 article, Escobar reviews the development of a cluster of overlapping "post-constructivist political ecologies" that are promising in this regard. What does a post-constructivist political ecology look like? There are multiple answers to this question. Many of these works embrace realism, but not in the same way. Aletta Biersack, for example, argues that political ecology cannot afford to surrender realism.[66] She seems to embrace the kind of critical realism championed by Tim Forsyth: an approach that seeks to understand real environmental change through epistemological

[63]See Brosius's (1999) review article on anthropological engagement with environmentalism.

[64]Mitchell 2002, 4-5.

[65]This argument turns on readings of post-structuralism. Insomuch as post-structuralist political ecology was shaped by readings of Foucault, the distinction between constructivism and post-constructivism is fuzzy. In some readings Foucault, like Deleuze's (1988), he is an ontologist, distinct from post-structuralists like Derrida from whom everything is textual. Foucault insisted that the discursive always exists in relation to – and cannot be isolated from – the non-discursive. That said, many post-structural political ecologists did read Foucault in a way that privileged texts and discourse over materiality.

[66]Biersack 2006, 28.

skepticism – the position that the real can never be understood in any final way – while retaining a belief in biophysical reality beyond human experience.[67] Scholars influenced by science and technology studies have emphasized nature-culture hybrids constituted through biological, discursive, scientific, and technical processes.[68] This new literature, Escobar writes, "builds on the efforts at working through the impasses and predicaments created by constructivism, radicalizing them, while at the same time returning to questions about 'the real'."[69] A key concept in recent neo-realist (or post-constructivist) political ecology inspired by Latourian actor-network-theory and Deleuze is the nature-culture assemblage, a heterogeneous collection of elements including knowledges, practices, values, legal regimes, and material structures, and non-human life.[70]

The explicit challenge to the nature-culture dichotomy and attendant embrace of hybridity has been theoretically stimulating and methodologically frustrating. In a recent review article, geographer Bruce Braun called for political ecologists to attend not only to the existence of assemblages, but their organization.[71] Anthropologists have long paid attention to social organization around circulation,[72] but have only recently begun to address the infrastructures that make circulation possible.[73] Assemblages, as Stephen Collier and Aihwa Ong point out in a recent work on the subject, are not unstructured but

[67]See Forsyth 2001 on critical realism and political ecology.

[68]Braun 2008.

[69]Escobar 2010, 91.

[70]See, e.g., the different neo-realisms of DeLanda 2007, Deleuze and Guattari 1987, Latour 1999, 2005. In political ecology, see the work of Escobar 2008, Helmreich 2003, Moore 2005, Raffles 2002.

[71]Braun 2008, 675.

[72]Appadurai 1986, Mauss 1990[1925].

[73]Anand 2011, Barnes 2010, Barry 2006, Collier and Lakoff 2008, Collier and Ong 2003, 2005, Harvey 2010, Harvey and Knox 2008, Humphrey 2005, Larkin 2008.

given form through the specificities of infrastructures.

> 'Infrastructure' designates specific institutional, material, and social conditions through which the functioning of a certain technology, ethical regime, form of regulation, or mode of communication is either enabled or impeded. It inscribes the space and form of limited, finite, and localizable relationships and effects that occupy a certain space and concretely link -- or distinguish and divide -- various objects, spaces, techniques, individuals, and social groups. An infrastructure allows these elements to come into communication but does not necessarily organize them in terms of a common structural or logical principle.[74]

Collier and Ong do not discuss ecology, per se, but explain that the "complex infrastructural conditions that allow global forms to function" interact with other elements "in contingent, uneasy, unstable interrelationships."[75] In the discussion that follows, I built upon their claim and show how an emphasis on infrastructure is useful for thinking through problems of scale, boundaries, and politics in political ecology.

Infrastructure Studies

The term infrastructure came to English from French, where it referred to substrate material below railroad tracks. The prefix *infra-* means below, beneath, or within. *Structure* has various meanings and, of course, carries significant intellectual baggage, but might be defined as the relation of the constituent parts of a whole as determining its nature or character.[76] The concept has been perhaps most widely used in economics and planning, where it refers to capital investments that facilitate directly productive economic activity or development.[77] We typically imagine infrastructure as the large technical systems (transportation, energy, water management, waste

[74]Collier and Ong 2003, 422.

[75]Collier and Ong 2005, 12.

[76]Oxford English Dictionary 1989.

[77]Lee 2009, 382-383.

management, and communications) that facilitate the circulation and distribution of people, materials, energy, and information across space. But, as scholars of science and technology have shown, infrastructures are never purely hardware. They are sites where "hard" technologies are interwoven with "soft" cultural, political, and economic systems.

The Panama Canal is an illuminating site to think about infrastructure, because the waterway supports international commerce and, at the same time, is supported by its own technological, human, and natural support systems. Science and technology studies scholarship on the development of systems like the canal emerged in the mid-1980s following the publication of Thomas Hughes's influential history of electrification.[78] Although it is beyond the scope of this introduction to review the large technical systems literature inspired by Hughes's work, it is important to highlight some of the salient lessons that emerged. First, technologies are understood as parts of the larger wholes – or systems – that support and sustain them.[79] The entire system is the unit of analysis, not an individual artifact. Second, technical systems emerge, stabilize, and develop.[80] They have life cycles that can be studied in historical time. Third, system builders – individuals, teams, and institutions that create systems and make them work – design and build projects with socio-technical content.[81]

Infrastructure studies builds upon the insights of the large technical systems research and conceptualizes those systems in a manner more amenable to ethnographic

[78]Hughes 1983.

[79]Hughes 1987.

[80]Hughes 1987, Mayntz and Hughes 1988, Summerton 1994.

[81]Coutard 1999, La Porte 1991.

research. The points listed above apply to infrastructure studies, but there are several distinctions. First, the idea of a large technical system focuses attention on a hard technological core,[82] but today the term infrastructure often refers to the socio-technical institutions that support education, governance, computing, and public health.[83] Second, infrastructures can be understood as shaping a *relational space*, rather than situated within a single scale or nested scales. Third, infrastructures are *political*. The values and priorities of past designers are embedded in socio-technical systems and quietly influence the present. System design and maintenance both reflect and reproduce patterns of inequality. Fourth, infrastructures *cross and act as boundaries*. Below, I develop these final three points specifically with regard to issues of scale, politics, and boundaries in political ecology.[84]

Infrastructure and Scale-Making

Infrastructure studies scholarship has addressed issues of scale. Paul Edwards writes "infrastructure, as both concept and practice, not only bridges…scales but offers a way of comprehending their relations."[85] His method, mutual orientation, is a call to study infrastructures at a variety of intersecting scales, from the micro-scale research advocated by actor-network theorists and ethnographers to the macro-scale studies of large technical systems scholars.[86] Scales reflect, on the one hand, the epistemological

[82]Edwards 2003, 200.

[83]See, e.g., publications on the infrastructures of education (Twigg 1994), governance (Globerman and Shapiro 2002), computing (Foster and Kesselman 2004), and public health (Baker et al., 2005).

[84]This is a heuristic strategy intended to clarify my main points. As will become clear through reading the paragraphs below, issues around scale, politics, and boundaries are inextricable in practice.

[85]Edwards 2003, 186.

[86]Edwards 2003, 192.

decisions of the researcher. However, as scholars of complex systems have observed, some patterns in the world are observable only at certain scales.[87] How do we reconcile this apparent contradiction between epistemology and ontology? I argue for attention to scale-making practices and technologies rather than defining scale *a priori.*[88] For Bruno Latour and Anna Tsing, scales are not neutral, but purposefully brought into being – proposed, practiced, and transported.[89] Tsing, in particular, argues that the linkages between scale-making projects – in her case, finance capital, franchise cronyism, and frontier culture – are sites for making sense of global connection.

I argue, drawing on Doreen Massey's theory of relational space, or space-time, that global connection should also be understood at the sites where the roads that support Tsing's frontier culture intersect with the agencies of rivers, rhizomes, and mosquitoes.[90] For Massey, space is an ongoing production, a "constellation of on-going trajectories …[that are] not only of the human but of the nonhuman too – the buildings, the trees, the rocks themselves, all moving on, changing, becoming. It is the multiplicity of trajectories that it is important to capture – not travelling across space conceived of as a continuous surface, but travelling across stories."[91] Her relational space resonates with philosopher of science Manuel DeLanda's argument for a flat ontology in which each scale has "its

[87]See DeLanda 1997 and 2000, on scale and flat ontology.

[88]This speaks to central issues in the scale debates in human geography too extensive to engage here. Reviews include, e.g., Brenner 2001, Marston et al. 2005, Smith 2000.

[89]See Tsing 2005, 57-60 and Latour 2005, 183-187.

[90]One of the problems with Latourian actor-network-theory is that, as Robert Kohler (1994, 6-7) points out, although he urges scholars to take non-human actors seriously, he does not, for example, deal with the biology of viruses in his study of Pasteur.

[91]Massey 2005, 92.

own history, occurring at its own tempo, even if these histories interact."[92] What emerges sounds like ecology, but a more heterogeneous and historical ecology than we generally find in political ecology. In terms of empirical research, it recalls the multi-scale historical ecology that Carole Crumley pioneered in Europe: reading landscapes through the intersection of *longue durée* geological and climatic patterns, the recovered histories of forgotten roads and anthropogenic forests, and the intimate rhythms of everyday life.[93] I translate this eclectic sensibility to a different site and set of concerns.

Infrastructure and Politics

The infrastructural approach to politics, like scale, is relational. It focuses our attention on the kind of politics that received little attention in political ecology before the recent post-constructivist, or ontological, turn. Marxian political ecologists conceptualized politics in structural terms defined by capitalist political economy. Power acted downward upon rural people and local environments, leading to a politics of domination and resistance. Post-structuralists, focused on the constitutive power of discourse, emphasized the politics of possibility opened through other ways of knowing. The political ecology of infrastructure engages what Annemarie Mol calls ontological politics:

> *Ontological politics* is a composite term. It talks of *ontology* – which in standard philosophical parlance defines what belongs to the real, the conditions of possibility we live with. If the term 'ontology' is combined with that of 'politics' then this suggests that the conditions of possibility are not given. That reality does not precede the mundane practices in which we interact with it, but is rather shaped within these practices. So the term *politics* works to underline this active mode, this process of

[92]DeLanda 2000: 6.

[93]Crumley 1987b, 1994, 2000, 2007.

shaping, and the fact that its character is both open and contested.[94]

A neo-pragmatist politics has been central to infrastructure studies. The conditions of political possibility are not given, as Mol writes, but shaped through our relations with the built environment. Language and governance are important political sites, but so are sites of design and (literal) construction. Thus, infrastructures play a critical role in organizing contemporary political ecologies, particularly the systematic dispersal of environmental vulnerability across space. Environmental catastrophes, economic disparities, and the political spaces of hope and despair are bound up with the built environment. For example, scholars have shown that famines are not confined to where natural events like droughts occur, but also the product of markets and distribution systems.[95] Infrastructure created in historical contexts of discrimination both reflect and reinscribe human inequality.[96] Langdon Winner's theory of technological politics has been very influential in this regard. Arguing that technologies are political phenomena in their own right, he writes, "The issues that divide or unite people in society are settled not only in the institutions and practices of politics proper, but also, and less obviously, in tangible arrangements of steel and concrete, wires and semiconductors, nuts and bolts."[97]

The initial technical decisions made by engineers and designers are important, because they give infrastructures a path dependency.[98] Even as the new is continuously

[94]Mol 1999, 75. Other recent scholarship on ontology and politics includes: Blaser 2009, de la Cadena 2010, Latour and Weibel 2005, and Hacking 2002.

[95]Davis 2004.

[96]Edwards 2003.

[97]Winner 1986, 29.

[98]Callon 1995.

layered over the old, the present is shaped by past decisions, contingencies, values, politics, and the standards of worlds that have passed. Transportation systems are a great example of this type of layering. Thus, the infrastructural politics of the present must be understood in terms of past biases and assumptions, decisions and actions. Geoffrey Bowker and Susan Leigh Star have called scholars to conduct infrastructural inversions, or archaeologies of the organizational work and arrangements embedded in systems.[99] My research follows their call by inverting the standard history of the Panama Canal as a large technical system and attempting to recover the politics of the past.

If infrastructures format relationships among humans and non-humans, as I argue above, they do so with normative force. As I show in Chapter 3, for example, transport routes in Panama are not designed to move everything and everywhere, but to channel flows along specific paths reflecting particular political-economic priorities. Roads, dams, and electrification projects are the symbols, organs, and connective tissues of state-making efforts. There is also a politics of aspiration associated with infrastructures. Infrastructures do not simply benefit or hurt people in a crude political-economic sense. They also enchant people and inspire unexpected forms of use and engagement.[100] This reminds us that, technically and politically, infrastructures do more than they are supposed to. People modify and use them for purposes other than those for which they were intended. Thus, possibilities are not fixed, as Mol says, but shaped within practices.

Infrastructure and Boundaries

[99]Bowker 1994, 104; Bowker and Star 1999, 234; Star 1999, 380.

[100]See, e.g., Larkin 2008 on the arrival of media technologies in Nigeria.

Infrastructures cross and act as boundaries, creating edges and centers.[101] On the one hand, infrastructures establish limits, points past which the movement of people, information, and objects is restricted or slowed. On the other hand, they are meeting points: sites of convergence, attraction, translation, and negotiation. Susan Leigh Star and James Greisemer developed the analytic concept of boundary objects to highlight how different groups successfully work together across social and economic difference.[102] They argue that mobile objects like diagrams, maps, and metaphors "are plastic enough to adapt to local needs and the constraints of several parties employing them, yet robust enough to maintain a common identity across sites."[103] By inhabiting multiple social worlds simultaneously, they form a common boundary. Star and Bowker make a similar move with infrastructure, arguing that scholars should conceptualize it as relational rather than singular. Boundary infrastructures, they argue, come into being, persist, and fail in relation to the socio-material practices of the communities that accrete around them.[104] Therefore, they are particularly amenable to multi-sited ethnography.

Star calls for an ethnography of infrastructure: qualitative research on the relationships between infrastructures and the human communities that build, use, and are affected by them.[105] Over time and through practice, the boundaries between the formal and informal aspects of infrastructure are blurred.[106] They change as people learn tricks

[101]On the edge/center nature of boundaries, see Marquardt and Crumley 1987, 8.

[102]Star and Greisemer 1989.

[103]Star and Greisemer 1989.

[104]On objects as bundles of relationships, see de Laet and Mol 2000, Latour 1999, Mol 1999, 2002.

[105]Star 1999.

[106]Bowker and Star 1999, 53-54.

and adapt strategies for taking advantage of or dealing with the problems associated with the systems they encounter. "This evolution," Star and Ruhleder wrote, "is facilitated by those elements of the formal structure which support the redefinition of local roles and the emergence of communities of practice around the intersection of specific technologies and types of problems."[107] Another important point is that people and communities interact with multiple infrastructures, which are often networked with one another over great distances.[108] People live with infrastructure – shaping it as it shapes them – but it also exceeds individual capacity to know and act. Therefore, infrastructure allows disparate elements (like the machete and the freighter) to come into communication, but does not necessarily organize them according to a fixed cultural, political, or economic principle.[109] The body of my dissertation focuses precisely on the moments when and sites where infrastructures are ill-defined and come into conflict with one another.

MAP OF THE DISSERTATION

The dissertation brings together four shadow histories,[110] of the Panama Canal. The chapters are each organized around an object (water, bananas, concrete, and forests) and a theme (control/excess, governance/margins, politics/mobility,

[107]Star and Ruhleder 1996, 132.

[108]Graham and Marvin 2001.

[109]Collier and Ong 2003, 423.

[110]The term "shadow history" is Peter Redfield's (2000). He writes, "Beyond ethnography, a key task for any anthropology concerned with modern life involves the writing of what I call 'shadow histories,' accounts of the very real alternatives to the primary ways things have been done or understood…The realm of shadows contains partial differences, similarities, and overlaps, and it is in this world that we find reflections between interconnected varieties of human experience. The greatest illusion of history proper lies in the implication that past actions have singular roots and consequences, clearly visible under the proper light…As well as documenting the ever–shifting geography of human activity in the present, its practitioners can confront modernity in reverse, sketching shadows of industry and sense filtering between places and times." (16). The notion of a shadow history refracts Michel Foucault's philosophy of history as articulated in "Nietzsche, Genealogy, History" ([1971]1984) through the prism of a historical anthropology.

nature/infrastructure). What the chapters have in common is that they use an object to examine a moment of transformation in infrastructural and ecological relationships on the isthmus during the twentieth century. These four objects brought together new networks of people and, at the same time, engendered conflicts over the appropriate use and distribution of natural and economic resources. I arrived at the events, topics, and themes explored in the dissertation chapters through the accounts of a different set of actors than those who generally narrate the canal. I conducted semi-structured interviews, oral histories, and participant observation with farmers, bus drivers, maintenance men, and state functionaries between 2006 and 2010. Yet, across this diversity, I found remarkable consistency in what people define as the important moments in regional history. These were the moments of breakdown and transformation when region-making projects collided with or diverged from one another – when the changing governmental, technical, and ecological boundaries of the Panama Canal system suddenly came into tension with the trajectories of other groups: the development aspirations of the Panamanian state, the logic of banana export agriculture, or the landholding dreams of smallholder farmers.

Chapter One (Water) reorients the history of the Panama Canal by focusing on water management rather than soil excavation. I retrace the transformation of the volatile Chagres River and its tributaries into a manageable water source for shipping during the first decades of the twentieth century and the concomitant depopulation of the US Canal Zone. I examine key elements of the historical engineering work (constructing locks and dams) and calculative practice (watershed surveys, hydrographic data collection, and cartography that went into assembling the core infrastructure still in use today. I show how water control was converted into political control, and vice versa by examining the

transformation of the Chagres River into a working canal. I recount two stories upon canal waters between 1910 and 1914 – the migration of displaced river communities and the research of a team of Smithsonian scientists – in order to highlight forms of control and excess produced through this system. New locks and dams interacted with unknown or unacknowledged webs of social and ecological relationships, producing unintended consequences. The aquatic space that emerged at Gatun Lake, the massive artificial reservoir flooded to store water for the canal, was neither a replica of engineers' designs, nor an elevated version of the lost world along the Chagres River. A new waterworld emerged around the trade route as it opened for business. I conclude by tracing how the water management network shapes the region around the canal in the present.

Chapter Two (Bananas) examines relationships among governance, labor, and life at the rural margins of the Canal Zone during the first decades of the twentieth century. I focus on the implementation and effects of a state program (1921-1932) that permitted former canal laborers – primarily poor, black West Indians – to lease formerly depopulated lands in the Zone for agriculture. In the decades after the waterway first opened in 1914, the enclave was largely rural, practically roadless, and poorly surveyed. Isthmian Canal Commission plans for the hundreds of square miles of land not immediately necessary for transportation or residential purposes became a critical point of tension within and beyond the commission. Who, if anyone, would be allowed to live and work on rural Zone lands? By foregrounding the implementation and consequences of the land lease program, I show that the US project was defined as much at its rural margins as its urban termini. The Canal Zone's rural question – how to best manage recently depopulated landscapes – seems minor, but it raised fundamental questions about

the ambitions and parameters of the larger US project in Panama. Moreover, tensions between transportation and agrarian livelihoods in the transit zone still persist today (Chapter 4). My strategy for navigating this environmental, technological, and cultural history is to retrace the rise and fall of export banana networks in the region. The banana is emblematic of the often unnoticed, or marginal, human and political ecologies around modern transportation routes.

Chapter Three (Concrete) investigates tensions around the construction of Panama's first domestic Atlantic-Pacific highway – the *Transístmica*– during the early-1940s. In the first part of the chapter, I use the highway as an entry point into persistent problems of mobility in the interoceanic transit zone. For centuries – beginning with the crumbling of the colonial-era *Camino Real* and ending with the early-1940s construction of the concrete highway – there had been no paved road between the Atlantic and Pacific Oceans. Even today, transportation remains a critical problem in Panama. People devote an inordinate amount of their time, money, and energy to moving around a space designed to facilitate transportation. Why is it so hard to get around a region organized around transportation? By situating Panama's road system within a more extensive networked infrastructure that also includes the canal, I show how the infrastructure built to move ships by water *across* Panama has historically disrupted the establishment of routes that would facilitate mobility greater *within* the region. Mobility and immobility on the isthmus are products of networked infrastructures that channel people and materials along routes that reflect the priorities of particular communities. The second part of the chapter draws on ethnographic material about a small road off of the Trans-Isthmian Highway to explore how, in the absence of formal infrastructure, people work

around its edges. They pressure local representatives for maintenance funding, devise micro-transportation systems, and work collectively to repair critical passage points.

Chapter Four (Forests) analyzes land use tensions around the Panama Canal as the surrounding watershed – a hydrological basin drained by six major rivers that flow into the waterway – became an administrative region during the 1977-1999 transfer of the US canal and Canal Zone to Panama. As the critical region, labeled the Panama Canal watershed, came entirely under Panamanian control for the first time,[111] domestic and international institutions pursued new forms of water management that emphasized environmental governance over civil engineering. Whereas canal administrators had previously emphasized the control of water in its liquid state, watershed management was an attempt to manipulate water flows by transforming land use practices in populated forests located as far as twenty-five miles upstream from the interoceanic shipping lane. I propose *natural infrastructure* – socio-ecological forms reimagined as support systems for global commerce – as a heuristic device for exploring the practices and politics of this momentous phenomenon in Panama and elsewhere. Natural infrastructure, like that made of concrete and steel, is embedded with politics. The construction of infrastructural landforms entails the restriction of alternative forms of land and resource use. It both enables and disrupts other projects. But building natural infrastructure also differs in significant ways from, say, roads. The objects of new designs are bound up in webs of affective and economic relationships that pre-exist their identification as matters of extra-local concern. Natural infrastructure is built upon expert knowledge, but its creation is

[111]Panama had never before controlled the entire Chagres River watershed, later defined as the Panama Canal watershed, because, before the US governed the Canal Zone, Panama was still a part of Colombia. Panama seceded from Colombia in 1903.

irreducible to more effective technologies of environmental visibility and valuation. In practice, remaking nature as infrastructure entails translational work around its objects: navigating webs of human-ecological interdependency, aligning of incongruent definitions and boundaries, and negotiating new responsibilities.

II. WATER: CONTROL AND EXCESS ACROSS THE PANAMA CANAL'S WATER MANAGEMENT NETWORK

If you want to see the Panama Canal in action, you will likely end up at the Miraflores Locks Visitor Center, located in the former United States (US) Canal Zone outside of Panama City. The modern facility – all cream adobe walls, towering plate glass windows, and marble floors – is a showcase for the history of the famous trade route. It contains a museum, a theatre, and a gift shop hawking canal neckties and tea sets. But the real action is outside. From a three-tiered viewing deck, visitors watch a slow parade of container ships, oil tankers, and cruise ships pass through locks built a century ago. I spent several afternoons at the locks while conducting fieldwork in Panama. Here, crudely, is how they work. A ship slides into the lock chamber and massive steel gates swing slowly closed. Then, a lockmaster opens valves in a water storage reservoir located above the locks. Water surges through culverts the size of subway tunnels embedded in the concrete walls of the lock chamber, enters cross-culverts that run beneath its floor, and then erupts upward. The surface of the water in the chamber bubbles and rises at a rate of two to three feet per minute, improbably lifting an enormous ship up from sea level.

The canal releases a staggering fifty-two million gallons of fresh water – equal to the daily domestic consumption of approximately five hundred thousand Panamanians, or one-seventh of the national population[112] – from the surrounding drainage basin into the

[112]Estimate based on Panama's per capita consumption of potable water, 106 gallons/day (EFE 2010).

Atlantic and Pacific Oceans with each passing ship. US and Panamanian state institutions have reorganized the Chagres River and its tributaries and created a canal by controlling water through infrastructure made of concrete, earth, and steel. But don't be fooled. A river still flows through the canal. Its occasional emergence reminds us that infrastructure controls and produces excess.

* * *

"Panama doesn't have oil, Panama has water." The comparison of national economies organized around these two fluids first caught my attention in an advertisement supporting a controversial hydroelectric project proposed on Panama's Caribbean coast. Later, while conducting fieldwork in the *campo* (countryside), I heard similar comparisons. "Water is the petroleum of Panama," one woman told me, "desert countries have petroleum and we have water." Ricardo Aleman Alfaro, the Panamanian Ambassador to Mexico framed the canal expansion in similar terms: "The Panama Canal is our oil." I passed it off as the legacy of some past media campaign and, before long, forgot about it. However, the water-as-petroleum discourse returned to my mind in December 2010 – in a much different context – a year after I returned from Panama.

* * *

The Panama Canal closed for only the third time in ninety-six years on December 8, 2010 when water overflowed the infrastructure designed to control it.[113] The events began when an inch and a half of rain, not unusual late in the rainy season, fell around the canal on December 7. However, the downpour became memorable over the next twenty-four hours as a stationary area of low pressure unleashed another four and a half inches. Panamanian meteorologists reported that the rainfall, associated with a *La Niña* weather

[113]The waterway closed for several months in 1915-1916 due to landslides and again in 1989 when the US invaded Panama to remove Manuel Noriega.

phenomenon pounding Colombia, Venezuela, and Central America, exceeded anything recorded near the canal in seventy-three years.[114]

When the floodwaters rose, I was back in North Carolina after conducting fieldwork in Panama. The shaky, handheld YouTube clip that played on my laptop screen shocked me. The boundary between land and water was blurred. Islands of unmoored trees and grass floated rapidly over the brown, sediment-heavy surface of the Chagres River as it flowed into Gatun Lake.[115] Moments later, the current propelled the island under the Gamboa bridge, splintering trees like matchsticks against metal girders (see photo below). The canal was closed midday on December 8 after the Panama Canal Authority reported an excessive volume of water flowing from the Chagres River into Gatun Lake and Alhajuela Lake, raising the water storage reservoirs to levels that threatened the interoceanic transit of ships.

People in many of the communities located along the banks of the river and the lakes – including the two villages where I lived and conducted fieldwork – were evacuated due to flash floods that displaced more than fifteen hundred people and killed eight in the community of Portobelo on the Atlantic coast. President Ricardo Martinelli announced a national state of emergency and said that populations around the canal should expect a reduced potable water supply due to the effects of the rain on purification plants. The canal reopened for business early the next morning – seventeen hours after closing – but the region's communities were unable to normalize so quickly.

[114]Kristina Pydynowski, Senior Meteorologist, Accuweather.com, Flooding Forces Panama Canal to Close (Al Jazeera)., La Nina from (BBC).

[115]http://www.youtube.com/watch?v=qnFB6yMOKy4&NR=1&feature=fvwp

* * *

I relate this anecdote about the flood of 2010 to make a point: the infrastructure built to manage water for the canal is inextricable from regional socio-political organization. This suggests an interesting parallel between economies organized around oil extraction and water management. Timothy Mitchell points out in the article "Carbon democracy" that states organized around petroleum extraction appear to be less democratic than other states. He suggests that the politics of oil and petro-states can be better understood by "following the oil itself" as it is produced, distributed, and converted into other forms of socio-technical organization, financial circulation, and political power. This is not, he argues, because the material properties of oil determine everything else, "but because, in tracing the connections that were made between pipelines and pumping stations, refineries and shipping routes, road systems and automobile cultures, dollar flows and economic knowledge, weapons experts and militarism, one discovers how a peculiar set of relations was engineered among oil, violence, finance, expertise and democracy."[116]

Water, of course, is not oil. As Mitchell makes clear, the specificities of fluids matter. Water takes on various appearances and meanings, but answers to a single name – except when it answers to others (swamp, steam, mud).[117] By paying attention to the technical arrangements and engineering work that have – for the most part – regulated the

[116]Mitchell 2009, 422.

[117]The nature of water is a metaphysical problem beyond the scope of this work, but I want to outline how I have navigated philosophical debates around water in my more restricted theoretical and empirical argument. In the history and philosophy of science (Miller, 2004; Vandewall, 2007) and cognitive psychology (Abbot, 1997; Chomsky, 1995; Malt, 1994; Putnam, 1993), these debates are embedded in larger tensions between essentialist and anti-essentialist philosophies. Thus, scholars have often asked "Is water H_2O?," a question that invokes the social construction debates of recent decades. I bracket this debate and to draw on archival and ethnographic data to analyze worlds built around water.

water flows of the Chagres River, I will analyze how a socio-technical system connects, excludes, and produces unexpected relationships among human groups and their environments. Attention to the infrastructure that channels water flow reveals something important about contemporary politics in this region of Panama. It is the heart of a socio-technical system that distributes channels water, but also economic possibilities and human vulnerabilities, unevenly across spaces and populations.

The users of large technical systems like the Panama Canal treat them as infrastructure, meaning that they are expected to operate smoothly in the background, providing support for more immediate projects. Thus, moments of breakdown like the flood of 2010 are also moments of visibility. They bring complex relationships among technologies, political institutions, environmental conditions, and cultural expectations to the foreground that are, for most people,[118] hidden. "The history of science," Michel Callon observes, "is nothing but the long and interminable series of untimely overflowings, of sociotechnical agencements, that have been caught out, unable to discipline and frame the entities that they assemble…a badly calculated boat, an ill-adjusted missile, or a wrongly formulated theorem reveals unsuspected worlds." Overflow raises important questions about the boundaries and scales of large technical systems. Where, for example, does the Panama Canal start and stop? At the limits of the shipping channel? At the ridgeline of the watershed that drains into the canal? At the edges of the global port network connected to Panama by oceanic shipping routes? At

[118]Star has observed that infrastructure is relational: "For a railroad engineer, the rails are not infrastructure but topic. For a person in a wheelchair, the stairs and doorjamb in front of a building are not seamless subtenders of use, but barriers. One person's infrastructure is another's topic, or difficulty." (1999, 380)

the dynamic frontiers of the climatic and hydrological systems that shape rainfall and drought on the isthmus?

As these questions suggest, the canal is difficult to pin down in the absolute, Euclidean space defined by cadastral mapping and engineering practices. One key problem is that scholars often construct their accounts on foundations of dirt. "Let the dirt fly" was a popular media refrain as men and machines excavated thousands of tons of earth in the Culebra Cut. The completion of the canal was held up as an illustration of modern man's triumph over earthly constraints – nature, disease, and even geology – recalling a modernist faith in development and technological progress that is now deeply troubled. If soil excavation is the story of canal construction, the canal is a "big ditch" between two oceans: a channel completed in 1914. The frame is frozen. But, if we put fast-forward just one year, a different picture emerges: a large landslide falls into the Culebra Cut, blocking traffic and closing the recently opened waterway for months. The canal is never frozen, but fluid, always changing and taking on different forms.

Anthropologists have recently encouraged us to think in terms of waterworlds: communities linked through a collective involvement with water.[119] The canal can be understood in terms of managed water, but this does not mean that these waters can be reduced to the canal. People in Panama have used the rivers and lakes associated with this major trade route for a variety of other purposes: agriculture, fishing, local transportation, scientific research, recreation, and household use. In moments of excess like the flood of

[119]The waterworld concept is developed in Hastrup 2009, Orlove and Caton 2010. Anthropologists that take a similar approach also include: Helmreich 2009, Hughes 2010, Lansing 1991, Raffles 2002, Velasquez-Runk 2009.

2010, the water management network of the Panama Canal reveals the persistence of connections around a system that usually seems like infrastructure. This chapter travels across the stories of several communities – engineers, Afro-Panamanian farmers, Canal Zone functionaries, and invasive plants – that intersected as a new water management network was assembled in Panama during the early-twentieth century.

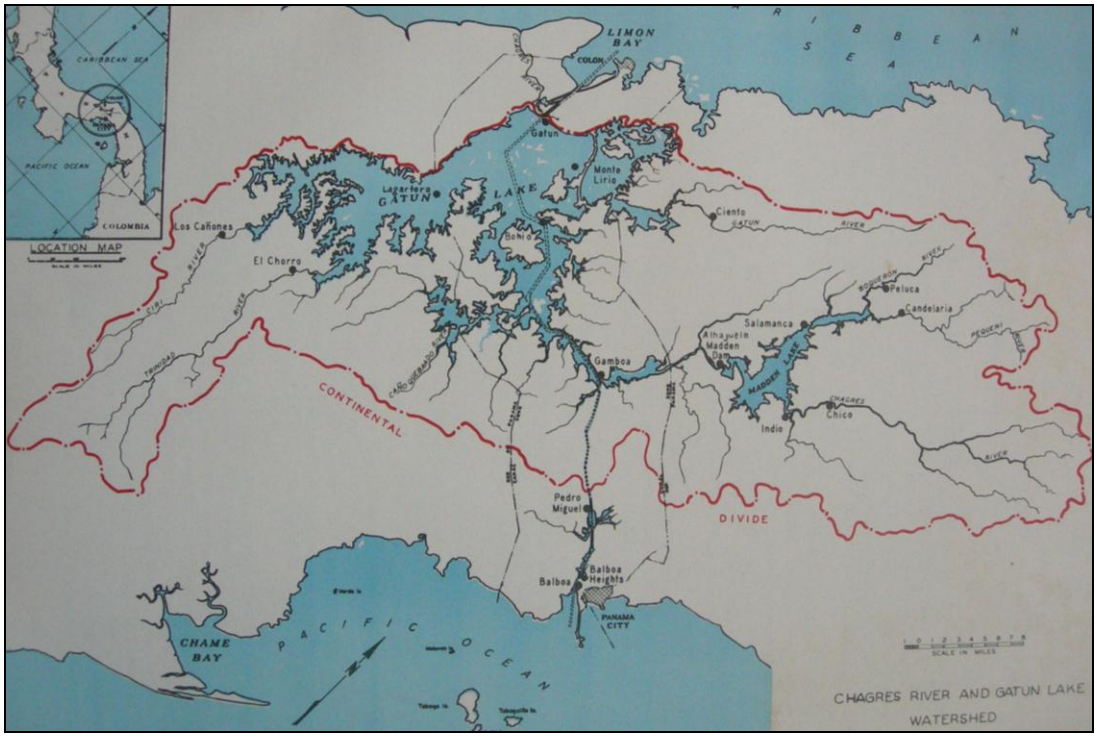

Figure 2.1: Map of the Panama Canal watershed. The watershed is comprised of the rivers that flow into Gatun Lake, (center) and Madden Lake (right).[120]

ORGANIZATION OF THE CHAPTER

The first section of this chapter focuses on water management infrastructure and control. I examine key elements of historical engineering work (constructing locks and dams) and calculative practice (watershed surveys, hydrographic data collection, and cartography) that went into assembling the core water management infrastructure that is

[120]Matthew 1949, 2.

still in use today. By following the transformation of the Chagres River into a working canal, I show how the control of water was converted into political control, and vice versa. The second section of the chapter focuses on water management infrastructure and excess. By following two stories that unfolded between 1910 and 1914 upon the rising waters of the canal – the migration of river communities displaced by the flooding of Gatun Lake and the field research of a team of Smithsonian scientists studying regional ecology – I show how locks and dams interacted with unknown or unacknowledged webs of social and ecological relationships, producing unintended consequences. The aquatic space that emerged at Gatun Lake, the massive artificial reservoir flooded to store water for the canal, was neither a replica of engineers' designs, nor an elevated version of the flooded world along the Chagres River. I conclude by suggesting how the assembly of the Panama Canal's water management network continues to shape the surrounding region in the present.

CONTROL: THE LOCK CANAL DECISION AND ITS IMPLICATIONS

In the summer of 1906, the United States Congress opted to fund the construction of a lock canal in Panama. The American route would, for the most part, follow the channel where the French *Compagnie Universelle du Canal Interocéanique* worked in the 1880s.[121] But there was one significant change of plans. Before bankruptcy and the death of an estimated 22,000 laborers, the French company had planned to excavate a sea-level canal: a channel that, if completed, would have allowed ships to travel unimpeded on salt water between the oceans. By contrast, the US design would move traffic over an aquatic staircase of six fresh water locks, where ships would be lifted up

[121]Board of Consulting Engineers, Panama Canal 1906.

from sea level to eighty-five feet and then lowered back down to sea level at the opposite side of the isthmus.

The lock canal decision was not inevitable. During the first two years of construction (1904-1906), engineering debates persisted regarding the advantages and disadvantages of competing canal designs: sea-level and lock-and-dam. The Board of Consulting Engineers for the Panama Canal was assembled in 1905 by President Theodore Roosevelt and charged with considering plans for the canal and making recommendations. After consulting the existing surveys and reports compiled by the French, the 1899-1901 US Isthmian Canal Commission study, and traveling to Panama to study the terrain firsthand, the group was unable to reach consensus. They produced two reports. The majority report advocated a second attempt to dig a sea-level canal and the minority report supported the construction of a lock canal. The proposals differed in estimated cost and time. The construction of the lock canal was expected to cost $139 million and take nine years, approximately half the estimated time and cost of the sea-level plan. Proponents argued that it would be safer for ships under Chagres River flood conditions, allow faster passage for large ships, cost less to maintain, and be easier to enlarge and defend.

The plans were circulated to the members of the Isthmian Canal Commission, Secretary Taft, and President Roosevelt for consideration, who all supported the lock canal. Nevertheless, the Senate Committee on Interoceanic Canals voted in May 1906 to support the sea-level plan. At a crucial moment when the plan was up for vote before the US Senate and House of Representatives, Chief Engineer Stevens sent word of a large

rainy season flood on the Chagres, which further convinced him of the navigational dangers that a sea-level canal without dams and locks might entail. The lock canal was approved by the Senate in late-June 1906 and, days later, by the House of Representatives. The decision was irreducible to engineering debates and technical specifications. It was also shaped by geopolitical concerns, economic issues, construction timetables, and climatic contingencies in Panama.[122]

Infrastructure and Circulation

The decision to build a lock canal and design of its concrete and steel chambers – 1050 feet long, 110 wide, and 85 deep – would have lasting implications within and beyond Panama. The lock chambers permitted passing ships nine hundred feet of usable length, ninety-five feet of usable width, and forty feet of usable depth, or draft. Why these dimensions? Congress passed a law stipulating that the waterway afford passage to the largest ships existing at the time of lock construction and "such as may be reasonably anticipated." Two commercial ships under construction for the Cunard line – 800 x 88 x 38 feet – would be the largest afloat.[123] However, 95% of ocean-going ships measured less than six hundred feet in length at the time.[124] The Panamax ship standard, a vessel that maximizes the permissible dimensions for transiting the canal, continues to influence

[122] See Board of Consulting Engineers, Panama Canal 1906 and US Army Corps of Engineers historian James Garber's (2011) analysis of canal engineering debates and environmental issues.

[123]Board of Consulting Engineers, Panama Canal 1906, 5. Initially, the lock width was to be 94 feet, but the US Navy requested that it increased to at least 120 feet. A compromise was reached that they would be 110 feet wide.

[124]Bakenhus, Knapp, and Johnson 1915, 81. Nearly a century later, Panamax ships – vessels that max out in at least one of the three dimensions: length, width, or draft – dominate Panama Canal traffic. However, many of the newest cargo ships are too large to pass through the locks.

ship construction and port design decisions around the world. Ships shaped the dimensions of locks and, over time, locks came to shape the dimensions of ships.

The lock decision fixed another standard with profound implications in the surrounding region: water volume. The canal engineers of the early-twentieth century designed a water management network that would meet the needs of contemporary and projected future shipping. The water required by this design – fifty-two million gallons per passage – precipitated the technological reorganization of the Chagres River and its tributaries to monitor, regulate, and deliver enormous amounts of fresh water.[125] The technical specificities of locks and dams mediated relationships between global commerce and regional ecology. They produced a set of conditions in which water and ships had to conform as a condition of circulation.[126] Relationships among infrastructure design, water flows, and ship size were not determinant, but recursive. Flows of water and ships shaped infrastructure, which, over time, shaped flows of water and ships.

The Geological History of Panama

Topography – the arrangement of natural and artificial features of an area – plays a key role in the following discussion. Before proceeding, then, it will be useful to explain current scientific knowledge of the geological history of the Panamanian isthmus. As we now understand plate tectonics, the isthmus emerged over a subduction zone where two oceanic plates – the Caribbean Plate and Pacific Ocean Plate – met and

[125]Most water flows out of the Panama Canal system via the locks, but it also exits through the Gatun Dam spillway and hydroelectric turbine, through a system that diverts it for consumption in the terminus cities, and evaporation.

[126]Gaonkar and Povinelli 2003, 395.

formed a volcanic arc in a contiguous American tropical ocean.[127] The deepwater connection between the Pacific Ocean and Caribbean Sea began to close in the early Miocene, fifteen to twenty million years ago. Magma rose up through plate fissures, creating a broad underwater ridge that was still under a thousand meters of water. By eleven million years ago, an island archipelago with marine and coastal habitats appeared across what is today the southern half of Central America. Sediment runoff gradually filled in the spaces between the islands. Only three corridors remained connecting Pacific and Caribbean waters at the end of the Miocene: the Atrato basin in northwestern Colombia, the San Carlos Basin in northern Costa Rica and southern Nicaragua, and the Panama Canal Basin. By four million years ago, the water at these points was fifty meters deep. The closure of the Panamanian isthmus took place three and a half million years ago, dividing a single American tropical ocean.

The division of the seas was an event of great paleoclimatic, paleogeographic, and paleobiological importance. However, the division of the land bridge between North America and South America through the construction of the Panama Canal would also prove to be an event of lasting historical, political, and technical significance. The Panamanian isthmus created a barrier to the inter-oceanic movement of marine life, even as it facilitated the movement of a flood of terrestrial organisms between the North and South America. The Panama Canal follows the orientation of a northwest-southeast depression – roughly 20 miles wide with a maximum altitude of 650 feet – shaped by volcanic and sedimentary processes. As one of the lowest-lying and last connecting

[127]The geological history presented here is drawn from Coates 1997, Coates et al. 1992, and Collins et al. 1996. There is controversy about the timing and direction of the tectonic plate movements that led to the formation of modern Central America and Panama. I summarize the most widely accepted findings.

points on the Central American land bridge, the basin is defined by marine and terrestrial deposits sedimented on top of volcanic basement rock.

The Lay of the Land

US civil engineers needed to learn about the hydrogeology of the isthmus when canal work began. The French had planned to excavate a sea-level canal with water supplied by the connected oceans, so determining the volume of water flowing through the river system had not been a priority. Consequently, they built only three gauging stations along the entire length of the Chagres for measuring water flow. No instrumental survey of the river's drainage basin, or watershed, had been conducted, so its area and water runoff were only generally known. For a lock canal, by contrast, knowledge of the volume, speed, and variability of water flows, as well as the overall area of the watershed, was critical. "The vital question," wrote Henry Abbot, hydrologist and retired Army Corps of Engineers Brigadier General, in 1905, "was to determine whether the Chagres will supply all the needs of the Canal in seasons of low water. Any reasonable doubt here would be fatal to the project of a canal with locks…"[128]

Abbot's "vital question" of water supply in the rainforests of Panama seemed ludicrous to more casual observers on the isthmus. The authors of one among a raft of books praising the triumphs of the canal project commented on what they understood to be excessive water volume in Panama: "The November visitor to the Zone who has seen the floods of the Chagres carrying before them trees, houses and bridges, submerging steam shovels, destroying miles of railroad, will never question the adequacy of the water

[128]Abbot 1905, 105.

supply."[129] Abbot, by contrast, was among the most knowledgeable experts about isthmian canal engineering debates. He served on the Board of Consulting Engineers and its predecessor, the *Comite Technique*, an international body of engineering experts assembled by the French New Canal Company in the 1890s to consider the future of the canal after the failure of the initial French project. Precipitation is seasonal in Panama, with roughly a nine-month rainy season and a three-month dry season. Mitigating these changes in precipitation and river discharge was critical to engineers' plans.

In order to make the lock design functional throughout the year, a water management network would have to be assembled around the Chagres River and its tributaries to ensure a consistent water supply. Its centerpiece would be a massive artificial storage reservoir – Gatun Lake – that would collect water during the nine-month rainy season in order to operate the locks through the three-month dry season. Its secondary purpose was to "tame" the volatile Chagres River by absorbing the periodically surging floodwaters that might threaten passing ships.[130] Knowledge of the limits and area of the Chagres River watershed was necessary to estimate the flow of water into the lake and, by extension, water supply available to the canal. During the first years of canal construction (1904-1908) engineers had been working with piecemeal watershed data collected by state- and privately-funded surveys that dated to the mid-nineteenth

[129]Gause and Carr 1912, 62-63.

[130]Prior to and during the canal construction era, the Chagres – like other large, volatile rivers – was ascribed an almost god-like agency. After the opening of the canal, the river was often described as transformed from moody, raging, and torrential to a "beast of burden quietly carrying the ships to and fro." (Bakenhus, Knapp, and Johnson, 1915, 47) Another American author wrote, "The Chagres River is one of the moodiest streams in the world. Now it flows along as a peaceful, lazy little tropical river not over two feet deep, moving sleepily on its journey to the sea. A day later it may become a wild, raging torrent, forty feet deep, madly hastening on toward the sea. Once there was nothing to oppose its moods, and it swept out to sea like a tidal wave." (Bennett 1915).

century.[131] In order to accurately estimate the volume of water that would flow into Gatun Lake, engineers and hydrologists needed hydrographic data and survey data on the topography and surface area of the Chagres River watershed. When Wm. Silbert, head of the Department of Locks and Dam Construction wrote Chief Engineer Goethals to request funds for a hydrological survey of the Chagres River watershed in 1908, engineers were using a "sketch map" at a 1:300,000 scale from the 1899-1901 Report of the Isthmian Canal Commission, too rough for their purposes.

The Hydrographic Survey, Watershed Maps, and the Politics of Topography

Silbert wanted to begin the survey quickly. Caleb Saville, an Assistant Engineer, did the logistical work. He requested letters of introduction to Panamanian politicians in upper watershed localities and necessary survey equipment: transits, Y-levels, lining rods, compasses, hand levels, barometers, field glasses, and stadia rods. The first survey party entered the field in November of 1908, the year that soil excavation at Culebra Cut peaked at thirty-seven million cubic yards.[132] As thousands of laborers toiled in the cut, a small group of three engineers and fifteen laborers pulled their canoes ashore and made camp miles upstream on the Chilibre River. The work of measuring and mapping the watershed was humble in terms of manpower, but early surveyors contributed to a body of hydrographic knowledge and cartographic representation that was also critical to the success of the canal as a technical and political project. The *Canal Record*, the official newspaper of the Isthmian Canal Commission, described the lands to be surveyed: "The

[131]The earliest reported survey of the watershed is one published as a map in 1864 by the Colombian government. In 1873, an American expedition led by Commander E.P. Lull and Liet. F. Collins, both of the US Navy, made a traverse survey along the Chagres River. There were more than a hundred in the party and they ran line levels, prepared maps, charts, and statistical tables (McCullough 1977, 63). The Isthmian Canal Commission conducted a rough survey of the watershed between 1904 and 1907.

[132]McCullough 1977, 529.

country above Gamboa is so sparsely settled that the surveying parties will be supplied by cayuco [canoe]…the country affords a bare living to the few negroes who inhabit it."[133] This quote may suggest the demographic "emptiness" of the upper watershed, but it also illustrates the colonial lens through with through which many early canal administrators viewed non-white people, rural livelihoods, and forest landscapes (Chapter 2).

By the end of 1908, four parties with twenty to twenty-five members each were surveying the watershed. They faced constant environmental, social, and technical challenges. Rivers flooded and made boat travel, the only mode of transportation in the region, difficult. The boat operators and laborers who cut trails through the forest to lay survey lines quit or left, unexpectedly, to participate in extended New Year's celebrations. Engineers became sick. Necessary equipment broke and was sent for repair. Days and sometimes weeks were lost through each of these difficulties. But, ultimately, the parties completed a traverse survey of the Chagres River basin up about five miles below the watershed's ridgeline. They located basic points on the ridgeline and omitted some smaller rivers altogether. The map produced using survey data was at a 1:150,000 scale. It was still rough, but had twice the detail of the previous map.

The impetus for the 1908 Chagres River watershed survey was to acquire more detailed hydrological knowledge for engineering purposes. But water management and politics were inextricable in the transit zone. Canal administrators instructed the Chagres survey teams to expand topographical and landscape data collection to twenty feet above and below the surface level of the future Gatun Lake in anticipation of the US managing

[133]Canal Record, Nov. 18, 1908.

lands that, at the time, were still Panamanian.[134] In Article Two of the Panama Canal Treaty of 1903, Panama granted the US the "use, occupation, and control" in perpetuity of a ten-mile-wide strip of territory – the Canal Zone – bisecting the narrowest part of the isthmus. However, in addition to near-sovereign powers within the Zone, the US had authority to expropriate additional lands and waters as necessary for the "construction, maintenance, operation, sanitation, and protection" of the canal.[135] This phrase, notable for its strategic vagueness, allowed the US to legally expand canal infrastructure and the political geography of the Zone in tandem as new conditions demanded.

Water demands transformed the physical geography of the transit zone, but they also reshaped political boundaries on the isthmus. Topographic maps had engineering uses, but they also had governmental uses. Drafted for engineering purposes – the control of water – topographic maps were used as tools of political control. When the one and a half mile-long earthen Gatun Dam was completed in 1911, the flow of the Chagres to the Atlantic Ocean was interrupted and Gatun Lake began to rise. US politicians invoked treaty rights to expropriate the lands to be flooded for the new lake and, in 1912, the Panamanian state recognized the right of the US to administer an additional seventy square miles in the future lake region. The lake would be maintained at eighty-five to eighty-seven feet above sea level. However, Panama ceded land to the hundred-foot contour, which would become the new political boundary between the Canal Zone and Panama around the lake. Through this process, topographic contour

[134]George Goethals, Isthmian Canal Commission Chairman and Chief Engineer, to Luke Wright, US Secretary of War, Dec. 25 1908, National Archives at College Park, Maryland, Record Group 185, Records of the Panama Canal, 1914-1950 (NACP RG 185), Entry 30, Folder 33-B-51(1).

[135]Hay-Bunau-Varilla Treaty (Panama Canal Treaty) 1903, Articles II and III.

lines mapped by surveyors for engineering purposes became political and, therefore, a site of struggle at the canal's margins.

The flooding of the lake coincided with the implementation of a depopulation policy in 1912 designed to "extinguish" competing private property claims in the Canal Zone and efforts to relocate thousands of Panamanians and West Indian laborers living below the level of the future lake – now designated by the US government as "squatters."[136] The stated motivation for rural depopulation was freedom to construct transportation infrastructure. Canal administrators also framed it as a means of improving sanitary control in the Zone. Autonomous, unmonitored West Indian and "native" populations were understood to pose disease threats to white communities. But, in private correspondence, administrators also argued that squatting might prove to be a significant problem for canal construction itself. Some administrators feared that, given an opportunity, the labor force would desert difficult construction work "for this easy life in the bush."[137] Depopulation, it seemed to administrators, would eliminate all three problems at once.

[136]The depopulation order extinguished all private rights and title to lands in the Canal Zone through direct settlement or before a joint US-Panamanian land commission. A large percentage of the claims paid by the US were to people considered "squatters" with possessory rights, but lacking legal title. See, e.g., "Following the depopulation order all private rights and title to lands in the Canal Zone were extinguished either by direct settlement or before the Joint Commission. A large percentage of the claims paid to individuals by the United States covered so-called 'squatters' rights, or the claims of parties who cultivated and built homes on lands in the Canal Zone without authority." NA Becker, Panama Canal Land Agent, to Jay Morrow, Governor of the Canal Zone, June 18, 1923, NACP RG 185, Entry 34, Folder 33-B-51(5).

[138]See, e.g., Canal Record, Aug. 2, 1911 on state concerns about rural squatters and the impetus for new trespassing laws. "It has been the custom in Panama for anyone who wished to cultivate land, to clear it and begin farming, without regard to the ownership of the land so occupied. This cultivation is of a very primitive kind, consisting chiefly of scratching the ground with a machete, or stick, and planting corn, yams, cassava, plantains, bananas, or other fruits and vegetables. Recently it has increased to an appreciable extent, and not a few of the Canal laborers, largely negroes, have left the works for this easy life in the bush. Both from the standpoint of the labor force, and the future leasing of the lands in legal and orderly manner, this squatting is undesirable."

Chagres River landscapes looked quite different on the ground than they did at a distance. Far from the political centers in Washington and Panama City, power operated in more intimate and incomplete ways. Topographical contour lines were only legible on the maps that Canal Zone police carried into the field. Policemen attempted to locate houses below the eighty-seven foot contour in order to document their occupants and distribute resettlement orders. The Canal Record described the progress of the depopulation efforts in 1912 and 1913:

> In anticipation of the rise of Gatun Lake the Department of Law has been engaged for the past year and a half in removing from the area the native families, who lived in detached houses scattered through the jungle, or in little villages clustered on the banks of streams or along the line of the railroad. In that time about 70 per cent of the population has moved out of the area, going either above the 87-foot contour or entirely out of the lake watershed. Some moved promptly on being notified, other had to be taken out when the water was almost at their doors; some have disappeared in the higher silence of woods creatures; and some have moved in bodies, forming new settlements in which is preserved the community life of the old. Most of the population of old Monte Lirio moved together up the Gatun River and formed a village which they call Limon.[138]

EXCESS: LIMON AND THE "LOST TOWNS" OF THE CHAGRES RIVER

I first arrived in Limon by road – the side of town opposite the lake – in March 2008. That morning, I boarded a *diablo rojo* (a brightly painted former US school bus) at a bustling mall on the suburban outskirts of Panama City. I wedged my knees into the torn vinyl of the seat in front of me for four hours and finally stepped off at a bus stop next to the *Transístmica*, the congested highway between Panama City and Colon. It was late in the dry season: hot, dusty, and yellow. Limon – one of my two ethnographic field sites – is located on a peninsula where the Gatun River flows into the lake. The lake's

[138] Canal Record, Sept. 10, 1911

calm green waters are interrupted by forested islands and the smooth, white trunks of dead forests flooded a century ago. The peninsula, which rises up abruptly from the lake, is covered with a couple hundred[139] small wood and cinder block homes, and crowned by the steeple of a catholic church. On the lake, you might see men in small motorboats fishing around the islands or someone paddling a canoe along the shoreline, but, for the most part, the water is quiet and the lake seems very natural. But, if you come to shore, pass through town and walk to a high point set back from the lake, you can see past the Panama Railroad line to the far side, where large ships pass through the shipping lane.

Limon attracted me for a couple of reasons. Before the transfer of the Canal Zone to Panama began in 1977, the Gatun River was a political boundary between the Zone and Panama. Limon, situated on the river, was the first Panamanian community on the lake's east bank. Consequently, I expected that ethnographic and oral historical work in Limon would illuminate the everyday lives and histories of Panamanians who have occupied this engineered landscape and, I expected, have had sustained socio-economic connections with the canal administrators. I was also attracted by an encounter weeks before in a town on the opposite side of the lake, which left me thinking about the historical ecology of the lake and the Chagres River.

[139] According to Panama's 2000 census, there were 164 households and 574 residents in Limon, an increase from the 106 households and 533 residents recorded in the 1980 census. (Government of Panama 1980, 2000).

Figure 2.2: Community of Limon with Gatun Lake in the background.

Señor Paulo Ortega[140] worked thirty-two years for the Panama Canal Commission. "Canal Protection Division," he said by way of introduction. He shook my hand and then presented – one at a time – three laminated identification cards, each with a different photo of a younger, more serious self. Paulo sat on the covered front porch of his house drinking cheap Night Train wine, a near-empty bottle at his feet. A wooden plaque hung on the wall in honor of his years of service to the canal. Paulo grew up here, the town of Escobal, but spent his working years in Colon and returned to his hometown after he received his pension. He explained that Escobal is descended from the towns flooded and relocated during the creation of Gatun Lake. In other words, the lower Chagres River valley has a diaspora: the lakeside towns whose founders migrated

[140] Throughout the dissertation, I have changed the names of the people interviewed while conducting the project in order to protect their identities. Following convention, the names of historical figures and contemporary public figures, like politicians, have remained the same. Place names are unaltered because it would be difficult to hide their identity in any meaningful way and, what's more, specific locations are important to my arguments.

uphill as the lake was flooded. The founders of Escobal came from the town of *Limon Viejo* (Old Limon), now underwater on the east side of the lake. Some of its inhabitants moved to the west bank and founded Escobal, others moved to the east bank and founded a new Limon. So, the two towns are "brothers," he said. The *pueblos perdidos* (lost towns) share more than a collective historical trauma. Even today, Paulo said, Escobal and Limon are connected through festivals, family lines, and the old culture of the river.

Fifteen minutes later, I was eating dinner in a small restaurant down the street when Paulo's granddaughter ran up to my table and handed me a scrap of paper with a scrawled note:

CUANDO EL
LAGO GATUN
SE FUNDO QUEDARON
EN LA PROFUNDIDAD
DEL LAGO
SON MONTE VISTOSO
CALLE BRUJA LIMON
SAN JUAN Y MONTE LIRIO

English translation: "When the lake was created, Monte Vistoso, Calle Bruja, Limon, San Juan, and Monte Lirio remained in its depths."

Back in Panama City, I filed the note away. But the story of the *pueblos perdidos* (lost towns) stuck with me, as did Paulo's reminder that the world of the river is not completely lost.

Gil-Blas Tejeira, a Panamanian journalist and author, popularized the term *pueblos perdidos* in a historical novel with that title published in 1962. Tejeira – a former teacher, librarian, provincial treasurer, and ambassador – captures the rhythms of everyday life and language among the national, economic, and ethnic groups that intersected during canal construction. The work is important, because but it gives the people displaced by Gatun Lake names, dreams, and stories. The flood was known as the "time when the lake killed the river" in lakeside communities that, sixty years later, still thought of themselves as *pueblos del río* (villages of the river).[141]

Nobody alive in Limon today ever saw the lower Chagres River. But, in oral history interviews, men and women in their seventies and eighties recounted stories of flooding, migration, and settlement passed down from their parents' generation and pointed the lake's surface above the former townsite. They talked about river life, old towns, and, in many cases, the places – Colombia, France, the Caribbean, and even Africa – that their ancestors had migrated from. The *pueblos del río* were populated by a variety of people attracted by jobs associated with the construction of the Panama Railroad in the 1850s and the French Canal in the 1880s, but especially Afro-Colombians and Afro-Panamanians. Many people in Limon trace their families to a town on the west bank of the Chagres River. Gatun was the largest and most important river community between 1849 and 1855 when railroad laborers lived there and, again, during the French canal project of the 1880s. Tejeira described the town before the flooding of the lake:

> The houses of Gatun were small and covered with zinc roofs, shaded by fruit trees and coconut palms. A church of wood and zinc was erected on

[141] See, e.g.,Velasquez Runk 2010 and Oslender 2002 on river systems as a form of spatial and cosmological among groups in Panama and Colombia, respectively.

> a cement platform with steps. Perhaps because the bell tower, also of wood, was not strong enough to support the weight of the bells, the two which, according to the *pueblo*, had been hung by a beam supported by two strong pillars. The economy of the *gatuneros* depended primarily on the bananas cultivated on the banks of the Chagres and its immediate tributaries…There were few whites, many mulattos, and mostly blacks, all well integrated.[142]

The flooding and depopulation have receded far enough in time that memories are hazy. But the *pueblos perdidos* still shape the present in other ways. One linkage between the world along the river and Limon today is Santa Rita, the town's patron saint. Every May 22, Limon celebrates the *fiesta patronal*, honoring Santa Rita with a procession, dancing, and music. One woman I interviewed remembered that, as a child, "The people came from far away and stayed for days. There were cars parked from my house down to the end of the street on both sides for the *fiesta* and the dances. The dances got so full!"[143] The official festivities, especially the Sunday procession, emanated from Limon's Catholic church, *Santa Rita de Castilla*, which was built through community subscriptions during the first decade after the flooding. Limon inherited this festival from *Gatun Viejo*, which also had *Santa Rita* as a patron saint. Tejeira wrote that Gatun would fill up with people that came to celebrate. Pilgrims attracted by a mix of the religious and the profane – a procession, cock fights, bowling, and dancing – came from along the train line, Colon, and the Caribbean coast. Celebrations began on the nineteenth and lasted most of the week.[144] The population of the lake region has historically been ethnically and culturally linked with that of Panama's predominantly black Atlantic coast around Colon. The *Santa Rita* festival illustrates a sense of

[142] Tejeira [1962]1995, 99.

[143] Emelia Cisneros, interview with the author, Limon, June 28, 2008.

[144] Tejeira [1962] 1995,157.

collectivity and community that is also manifest in other shared cultural features across the region: a shared idiom, home construction style, and diet.[145]

They say that this is the third community called Limon. The first, *Limon Viejo*, is now beneath thirty feet of water near where the Panama Railroad line runs over a steel bridge over the lake. It was near the confluence of the Gatun and Chagres Rivers before the flood. Oral histories make one thing clear. From a certain distance, the reservoir-making process around Gatun Lake seemed straightforward: survey, expropriate, depopulate, and flood. In practice, however, the reorganization of land, water, and society across hundreds of square miles or rural territory was a difficult, drawn-out process. The Canal Zone police and people they identified as "squatters" played a game of cat and mouse during the years of the flooding. I began to learn about these encounters in more detail after a schoolteacher in Limon turned up a wrinkled photocopy of a 1914 article, "*Vox climantis in deserto*," that appeared *The Independent*, a Spanish-language newspaper. The author, Benigno Palma, draws heavily on biblical allusions in his descriptions of the people of Limon as a nomadic tribe unjustly displaced by the lake and the Zone police.

At first, there were only eight Zone policemen working on depopulation in the lake basin. They reported destroying three hundred native houses below the eight-seven foot contour by early 1912, burning them to discourage future resettlement. Officials estimated seventy percent of the population was removed from the area by late in the next year. But that estimate was probably too high. So-called squatters abandoned their

[145] Heckadon-Moreno 1981, 5.

houses for other locations in the Zone, especially the new islands and forested banks formed by the rising lake. The story of Limon provides a good example of how difficult and politically charged depopulation was. Villagers in Limon Viejo were, according to officials, compensated for their land and improvements. Unbeknownst to the authorities, however, they quickly established a new townsite on the island that is now referred to as the second Limon. Around seventy-five people settled the island and began to farm neighboring islands. On December 17, 1914, representatives of the Mayor of Colon and the Canal Company selected a location for Limon on a peninsula above the hundred-foot contour line – in the Republic of Panama – on the north bank of the Gatun River. Police ordered the *Limoneses* (people of Limon) to move again, paid them to dismantle their houses and rebuild them at the location where the community is located today.[146]

When Gatun Lake reached its operating level in early 1914, it was the largest artificial reservoir in the world, spreading out over 164 square miles. Engineers' knowledge of topography, climatology, and hydrology proved sufficient to design and build a lock canal. However, as the challenges of depopulation suggest, little was known about the flooded region's social worlds. Less still was known of the area's ecology. The rising waters of the lake did not completely erase the world of the Chagres River valley. Instead, they also lifted people, fauna, and flora up to eighty-five feet above sea level. Plans interacted with unknown and unacknowledged webs of relationships, often

[146] For official accounts of the resettlement of the village of Limon from the perspective of the Isthmian Canal Commission, see Canal Record Sept. 10, 1913; Nov. 4, 1914; and Jan. 6, 1915. See also correspondence in NACP RG 185, Entry 30, Folder 33-D-11/G(2). For the Panamanian state perspective see Government of Panama 1916, 42. For Panamanian media perspectives on Limon and the politics of displacement generally, see Palma Nov. 14, 1914 and Diario de Panama Nov., 1914.

with unintended consequences.[147] The aquatic space that emerged was neither a replica of engineers' designs, nor an elevated version of the world along the river.

Historical Ecology at Gatun Lake

There are flooded forests beneath the surface of the lake. The smooth, white trunks of dead trees reach up from below the surface like bony arms. Soon after I began conducting fieldwork in Limon, my research assistant, Andres, brought me in his rectangular motorboat to the locations of Limon Viejo and the second townsite – an unpopulated, forested island. The boat's turquoise paint had flaked off in patches, revealing a red base coat and, where that too had flaked, rusted metal. Hawks flew overhead, scanning the water for fish. The sun overhead was bright, but mild. We motored around the islands and Andres brought my attention back to the dead forests. His right hand gripped the steering rod attached to the sputtering outboard motor as he leaned and pointed with his left hand to trunks visible just beneath the surface. The islands were hilltops above eight-five feet. Other high points rose are dangerously close to the surface, delimiting a network of passable aquatic trails across the lake. Developing a mental map of the underwater topography, Andres explained, is a critical part of being a *lanchero* (boat driver). Snags have sunk many boats, particularly those of the inexperienced, inattentive, and drunk.

[147] This formulation is inspired by James Ferguson's 1994 seminal analysis of international development through the lens of unintended side effects, or "instrument effects." See also Mitchell 2002 and Scott 1998 as exemplary of a growing body of critical social scientific scholarship that foregrounds unintended consequences.

Figure 2.3: Dead forests break the surface of Gatun Lake.

What lies beneath the waters of the lake? The Panamanian historian Guillermo Castro Herrera has written that the flooded landscapes were critical in the formation of historical identity on the isthmus and, as such, their reconstruction is among the most important pending works in Panamanian environmental history.[148] The textual data that Castro Herrera suggests for this reconstruction – technical documents and literary works – provide a specific type of information about the landscapes around the river shaped by the character of their authors' ecological knowledge and practice. Upper-level engineers and administrators often couched regional ecology in the broadest terms: jungle, swamp, and forest. By contrast, rural functionaries – land agents, policemen, and sanitation workers – displayed a more nuanced understanding of the landscapes that they spent their days patrolling, noting, for example, stands of "virgin" and secondary forest. The literary works like Tejeira's *Pueblos Perdidos* that focus on rural people and places – and these are limited – provide a sense of vernacular ecology. However, some of the best

[148] Castro Herrera 2005.

descriptions of these landscapes and their plants and animals come from natural scientists attracted by the rapid ecological transformations associated with canal construction.

In 1904, the year that the US began canal work, SP Langley, the Secretary of the Smithsonian Institution, contacted President Theodore Roosevelt to inquire about the possibility of conducting scientific work in conjunction with construction. "It seems likely," he wrote, "that the work in connection with the digging of the Panama canal will offer an opportunity for scientific research in various fields, such as geology, mineralogy, ethnology, archaeology, natural history, and other branches of science, which opportunity may never occur again in that region." Large civil engineering projects in the US had proven productive for the institution. "About the middle of last century, when the great western railway and boundary surveys were undertaken, such works of practical importance had usually attached to them members of the staff of the Smithsonian Institution and of the other scientific branches of the Government, who were thereby enabled to add greatly to our knowledge of various sciences and to increase our national collections, without in any way hampering the work and without considerable expense. Such scientific work has also been done by other countries in connection with their extraterritorial surveys and notably at the time of the construction of the Suez Canal." He concluded by asking that the president to authorize the Isthmian Canal Commission to support the project.[149]

[149] SP Langley, Smithsonian Secretary to President Theodore Roosevelt, Smithsonian Institution Archives (SIA), Washington DC. Office of the Secretary Records, 1903-1924, Record Unit (RU) 45, Panama Canal Zone Biological Survey Project, Box 42, Correspondence 1904-1914, Folder 14.

There were two motivations behind calls for a biological survey of the Canal Zone. The first, as Langley made clear, was professional opportunism – or, perhaps, parasitism. Scientists "attached" themselves to civil engineering projects. In particular, the extension of modern transportation lines into unstudied areas facilitated scientific fieldwork.[150] Infrastructural projects also provided comparatively comfortable fieldwork accommodations: clean beds, dining halls, and clubs. The second, more public, motivation was a nascent concern for salvaging and cataloguing the biological diversity that was being transformed through these very projects. In 1907, the American Society of Naturalists urged President Roosevelt and Congress to make provisions for a Biological Survey of the Canal Zone. The Society's stated concern was that the linkage of Atlantic and Pacific watersheds through excavation would precipitate the mingling of freshwater species from the two slopes and that marine species would travel over the waterway. This was an old concern expressed in new language. In 1567, King Philip II of Spain allegedly abandoned the idea of building a canal through Panama after the Dominican Friars he consulted returned with an apt biblical verse: "What God hath joined together, let no man put asunder."[151]

Twentieth-century naturalists, by contrast, had neither the power, nor the will to halt the canal project. The Society proposed a proto-environmental impact assessment that was politically toothless. They framed their project as ecological salvage, rather than

[150] This is a recurrent theme in the correspondence among administrators and scientists involved with the Smithsonian Biological Survey of 1910-1912. See Panama Canal Zone Biological Survey Project correspondence, SIA RU 45, Box 42, Folder 14; The relationship between transportation infrastructure and scientific collecting is also explored in contemporary Mexico in Hayden 2004.

[151] Goethals 1915, 2-3.P. 2-3.

conservation.[152] Smithsonian Secretary Walcott restated the importance of the survey before Congress: "Such a survey is necessary before the canal is completed, for it is believed that conditions of life will be changed after the canal is opened to commerce, and the waters of the Atlantic thereby joined with those of the Pacific. The organisms of the various watersheds would then be offered a ready means of mingling together, the natural distinctions would be obliterated, and the data for a true understanding of the flora and fauna placed forever out of reach."[153] President William Taft approved the plan for the Smithsonian Biological Survey of the Canal Zone in 1910. Secretary Walcott requested assistance from the United States Departments of Agriculture and Fisheries to assist a survey team of botanists, biologists, entomologists, ornithologists, and zoologists.

Henri Pittier, chief botanist, was the first to arrive in Panama. He had an ideal background for studying plants in the Canal Zone: a degree in civil engineering from Lucerne, Switzerland and a doctorate in natural sciences from Jena, Germany.[154] Pittier began collecting specimens on New Year's Eve 1910. He observed a "profusion of plants" flowering, far too many to collect without an assistant. "I stopped at the first plant that interested me, and there…within a radius of less than fifty meters, I collected eighty-four species in full blossom. And many more were in sight!"[155] Pittier observed that the flora of the transit zone, though diverse and uncatalogued, was far from pristine: "Most vegetation seen along the railroad is secondary and partly adventitious growth. It

[152] Resolution of the American Society of Naturalists, Dec. 30, 1907, SIA RU 45, Box 42, Folder 14.

[153] Smithsonian Biological Survey of the Canal Zone, Dec. 8, 1910, SIA, Dorothy Rosenberg Papers, 1963-1984, RU 7447, Box 11, Folder 20.

[154] Heckadon-Moreno 2004, 90.

[155] Henri Pittier to Walcott, Smithsonian Secretary, Jan. 1, 1911, SIA RU 45, Panama Canal Zone Biological Survey Project correspondence, 1911-1917, Box 43, Folder 9.

will [be] necessary to go to more remote districts to study real primeval conditions." As his first field report traveled by steamship to Secretary Walcot in Washington, four other Smithsonian Biological Survey scientists departed from New York to travel to Panama.

Pittier and the other scientists described anthropogenic landscapes all around the canal works. Plant ecology was radically transformed by excavation and sanitation work on the Pacific side around Culebra Cut and, more subtly, in the marshes that began to grow in the bottomlands of the Atlantic side that would soon be flooded to create Gatun Lake. Grass specialist AJ Hitchcock provided detailed descriptions of these landscapes. He arrived in Panama with his son in August of 1911. It was his first trip to the tropics. They were assigned two plain rooms on the second floor of the Old Hotel, on the edge of Culebra Cut. The Isthmian Canal Commission provided Hitchcock, like the other scientists, with free living quarters, railroad transportation, a book of coupons to shop in government commissary stores, and a Canal Zone map. In his initial report to the Department of Agriculture, he described his initial fieldwork as "very successful" – forty-two grass species collected in two days – but he was amazed by scale of the environmental transformations around the construction works: "the whole region is soaked with oil. It forms a scum on pools. Every water course and drainage is black with the destroyed vegetation. The jungle is cut away from along all the lines of drainage and a ditch dug to carry away the water rapidly, these ditches being oiled."[156] Hitchcock seems impressed by, rather than critical of, the sanitation work that had covered an entire region in oil scum and destroyed its vegetation. He, like the other survey scientists,

[156] AS Hitchcock to FV Coville, Botanist in Charge of Taxonomic and Range Investigations, Aug. 28, 1911, SIA, United States National Museum, Division of Grasses, Records, 1884, 1888, 1899-1965, RU 229, Box 11, Folder 1.

found that sanitation efforts and trains – if destructive – made fieldwork easier: "These clearings facilitate collecting for the jungle is impenetrable."

Hitchcock and his son extended their collecting efforts away from Culebra Cut via the Panama Railroad. They caught the 7:00 AM train every morning and rode to a different station, where they would get off and walk five to ten miles to the next. They carried cameras, a tripod, seed collection bags, and a notebook. The moist cleared areas around Culebra were dominated by an aggressive Para grass (*Panicum barbinode*) that Hitchcock described as a great boon for animal forage. They found new grass specimens as they walked along the railroad tracks: sixty-five species in a week. Hitchcock proudly noted that Esenbeck, the author of *Flora of Panama*, had listed only twenty-seven species, but allowed that many of the specimens he had collected on this trip were probably recent introductions. The most conspicuous grass in the future Gatun Lake basin was a tall reed (*Gynerium*) more than thirty feet high and terminated by a four foot long plume. Hitchcock reported that it formed "great areas," along the lower Chagres and adjacent bottomlands known as the Black Swamp.[157]

Gatun Lake was only fifteen feet above sea level when Hitchcock first saw it. Chief Engineer Goethals had asked him to examine grass vegetation on the rising lake to see if it might restrict navigation. Hitchcock was astonished by what he found. The plant life from the riverbed was floating to the lake surface and forming new ecologies:

> Thursday we went to Gatun to examine the Lake. We went to various points in the launch which drew 3 ½ feet, and made detailed examinations in a skiff. I was very much surprised to find Para grass (*Panicum barbinode*) growing in 7 feet of water. It was throwing out vigorous

[157] AS Hitchcock to FV Coville, Sept. 3, 1911, SIA RU 229, Box 11, Folder 1.

> stolons on the surface of the water. Below the surface there was a tangled mass of branching runners. I pulled up some that were twenty feet long and an indefinite length in addition…At another point I found *Hymenachne auriculata* in dense masses growing in 3 to 4 feet of water and producing vigorous runners. I had not previously observed this species any where on the zone, though it was abundant here. Certain other vegetation was growing in ten feet of water. A common species of *Paspalum*, *P. fasciculatum* was found occasionally here, the point of interest being the runners, which ordinarily have tight sheaths but in this case they ran along the surface of the water, the sheaths being inflated, supporting the runners like bladders. As you will remember this adaptation is conspicuous in the water hyacinth of Florida. It is a question how these grasses came to be growing in such deep water…Ultimately this dam will raise the water to the 85 feet contour line, but has now been raised about 15 feet…The grasses in many cases were growing on logs. When the water rose, the logs floated and thus became a centre for a mass of vegetation…The masses of vegetation growing in deep water, 6 to 10 feet have produce a substratum extending to the depth of a foot or two below the surface. This is made up of roots, rootstocks and accumulated dirt and debris. The measuring staff would meet with resistance until it was forced through this then would drop easily to the bottom. There was no evidence that the masses were in motion so I suppose they were still anchored by the original stump. This point could not be decided. If they ultimately became detached they would form floating islands. The economic question involved is of course is there danger that these grasses may threaten to interfere with navigation…But from the examination I have made and from what is know concerning the involved I did not anticipate trouble from this source.[158]

The invasive grasses turned out to be more of a problem than Hitchcock expected. They spread across Gatun Lake and up its river tributaries. Identified as *Eichornia azurea,* a close relative of the water hyacinth that had choked transportation on waterways in Louisiana, Florida, and Egypt, the rate of its proliferation alarmed administrators. Rafts of floating wood and dead plants exceeding a hundred feet in

[158] AS Hitchcock to FV Coville, Sept. 10, 1911, SIA RU 229, Box 11, Folder 1.

diameter – legacies of the river valley – were scattered over the lake surface. Water hyacinth spread over these "floating islands," binding the debris securely.[159]

Administrators pursued information on the invasive plant's introduction and dispersal, as well as treatments employed successfully elsewhere. Otto Lutz, Professor of Natural Science at the National Institute, Panama, wrote Goethals describing the hyacinth's twin dangers to the canal enterprise: not only did it threaten navigation, it provided an ideal breeding ground for mosquitoes. It should, he emphasized, be destroyed "wherever it occurs in the navigable waters of the Canal."[160] The lake was not only the future Canal route, but also provided the only means of transportation for rural people living in the vicinity. Farmers from Limon and nearby communities, who traveled over the lake to their fields and to market, complained that their canoes were unable to pass through the fields of water hyacinth.[161] Canal administrators debated their responsibility to rural agriculturalists, but conceded that the flooding of Gatun Lake – created to facilitate transportation – had, ironically, restricted local movement. The old foot trails that provided local access to the railroad line were flooded. And, now, hyacinth-choked channels restricted aquatic movement. A simple plant threatened to choke the waters of the mighty canal before it even opened.

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[159] See correspondence in NACP RG 185, Entry 30, Aquatic Plants (Hyacinth, Chara, Naias, Cabomba, etc.) in Canal Waters; Studies, Reports, Methods of Control and Elimination to Prevent Mosquito Breeding and Obstructions to Navigation, etc., Folder 33-H-4(1).

[160] Otto Lutz to Goethals, May 16, 1913, NACP RG 185, Entry 30, Folder 33-H-4(1).

[161] See NACP RG 185, Entry 30, Folder 33-H-4(2), e.g., RH Thourbourn, Baptist Minister, to Chester Harding, Acting Governor, Panama Canal, June 21, 1915. Thourbourn writes for New Providence, the neighboring community to Limon, "The undersign was asked by the members of the West Indian Colony in the Gaun Valley to approach you in their behalf…part of the Gatun Lake, that they have to use in going to their field, by small boats, is blocked up with what is called, the Water Cabbage that makes it very difficult. And they have no other way just now by which to go to their field. They humbly ask His Excellency if he would give some aid in killing some for them?"

Waterworlds at Gatun Lake

When Gatun Lake reached its operating level in early 1914, it was the largest artificial reservoir in the world, spreading out over 164 square miles of the Chagres River valley.[162] Even then, engineers recognized that its storage capacity would prove insufficient for canal purposes as traffic increased.[163] President Calvin Coolidge signed an executive order in February 1922 to create a second dam and water storage reservoir located on the upper Chagres River. The twenty-two square miles that would become Madden Lake were expropriated from Panama – again under the terms of the 1903 Panama Canal Treaty – and appended to the Canal Zone. The reservoir-making process enacted on the lower Chagres River at Gatun – survey, expropriate, depopulate, and flood – was then repeated on the upper Chagres. Water and politics came together around topographic contours that proved useful for engineering and administrative purposes. The assembly of the Panama Canal entailed two intersecting types of infrastructural work: civil engineering and human depopulation. The Chagres River system was reorganized according to the water demands imposed by the lock design, the climatic and hydrological specificities of Panama, and the increasing volume of traffic passing through the waterway. As water flowed downstream, a network of water management technologies were built further upstream. The human side of the story was primarily displacement and dispossession from the Canal Zone.

[162] Haskin 1914, 39-40.

[163] Kirkpatrick 1934, 84

CONCLUSION

This analysis of the Panama Canal's water management network illuminates how political and ecological forms accrete around the material specificities of infrastructure. In this chapter, I have attempted to recover the establishment of a system that channels and distributes water, but has also shaped the social relationships that have traditionally interested social scientists. By tracing the infrastructure that channels water for transportation purposes, I have attempted to show how a socio-technical system connects, excludes, and produces unexpected relationships among human groups and their environments. Engineers reorganized the Chagres River, but, as they did so, created a waterworld that exceeded their intentions: a techno-natural hybrid akin to what Richard White calls an organic machine.[164] This is an entity in flux where, over time, the combination of scientific, technical, and quotidian work, make the boundaries between the natural and the human, as well as the material and the political, difficult to distinguish. The canal, then, is unfinished. Even today, it surfaces and edges bear the marks of the hydro-political work done nearly a century ago: the eighty-five-foot surface water level, the boundary markers at the hundred-foot contour, the displaced towns perched on forested banks above a hundred feet.

[164] White 1995

III. BANANAS: INFRASTRUCTURE, GOVERNANCE, AND LABOR AT THE MARGINS OF THE US CANAL ZONE

Official photographs taken around the Panama Canal during the early-twentieth century are often similar in composition. At the center of the frame is a passing ship, a freshly paved road, a steel bridge, or railroad tracks stretching into the distance. People are often gathered around these modern technologies, elements of material culture that traveled, like most of them, to the isthmus in connection with a sprawling infrastructural project. Other photographs focus on people: white North American administrators posed in front of offices, black West Indian laborers at work, and many others. A visual pattern emerged as I sorted through thousands of Canal Zone photographs at the US National Archives. Banana plants cluster in the background reflecting the tropical sunlight. Their wide, tattered leaves slope across the edge of the frame. What can we learn about the canal by focusing on its human and ecological margins? What might the rise and fall of banana networks along this trade route reveal about the interplay of transportation infrastructure, governance, and taxonomies of labor at the margins of American Empire?

* * *

> In a word, then, here in the most important country of its size in the world, the Panama Canal is meeting an unprecedented problem: in three hundred twenty-five square miles of moderately suitable territory, more or less isolated, how nearly self-supporting shall this area be made, what sort of horticultural development should it have and how much? The foreground is somewhat out of focus at the present, but there are certainly some interesting possibilities in the perspective.
>
> - OW Barrett, *Horticulture in the Canal Zone*, 1915[165]

[165] Unpublished article. NACP RG 185, Entry 34, Folder 33-H-3(2). Barrett was a visiting horticulturalist in the Canal Zone when he drafted and circulated this article.

In 1903, Panama granted the United States near-sovereign power over a ten-mile-wide strip of territory for the future Panama Canal. That space, the US Canal Zone, has often been represented in both popular and scholarly writing as a massive construction site remade as a manicured, tropical North American suburb.[166] This narrative is somewhat misleading. In the decades after the waterway first opened in 1914, the enclave was largely rural, practically roadless, and poorly surveyed. The US Isthmian Canal Commission's plans for the hundreds of square miles of land not immediately necessary for transportation or residential purposes became a critical point of tension within and beyond the commission. Yet we know remarkably little about the role of rural governance in the canal enterprise. This gap is historically significant because the Canal Zone's rural question – how to best manage recently depopulated landscapes – raised fundamental questions about the ambitions of the US project in Panama. The account also suggests a shadow history[167] of the canal, an alternative way of conceptualizing the trade route's relationship to the nearby peoples and landscapes – a problem that resonates in Panama today.[168]

In this chapter, I examine the dynamic relationships among labor, life, and governance at the rural margins of the Canal Zone during the first decades of the twentieth century by analyzing the implementation and consequences of a state program (1921-1932) that permitted former canal workers – primarily poor, black West Indians – to lease formerly depopulated lands for agriculture. Why reconsider the Canal Zone from

[166] Frenkel 2002 analyzes the establishment of the Canal Zone as a suburban residential landscape between 1912 and 1940 as an effort to separate white North Americans from an array of "others": the Panamanian "jungle," Panamanian cities, and West Indian laborers and Spanish-speaking Panamanians.

[167] Redfield 2002, 16.

[168] See, for example, Chapter 4,

its margins? As Anna Tsing writes, "An out-of-the-way place is, by definition, a place where the instability of political meanings is easy to see."[169] The changing parameters of the US project in Panama were particularly visible across the hundreds of square miles of rural lakes, rivers, forests, and fields that comprised much of the Canal Zone. State authority was unstable across this region in political and ecological flux.

Marginality occupies an important place in anthropology. The discipline began as the study of marginal peoples, classified as such according to their distance from a perceived Euro-American geographical center or cultural norm. In this sense, marginality is *positional*: an ethnographic feature that marks human groups as different and thus implies a bounded notion of culture. By contrast, post-colonial theorists and other critical scholars have, since the 1980s, seen marginality as *relational*. They argue that asymmetries are not prior to, but produced within and through, Western humanist standards.[170] Difference is recognized as historically constructed and, as a corollary, a political position from which to interrogate colonial and imperial categories. My approach to marginality is *infrastructural*. I draw on scholarship exploring the intimate frontiers of colonialism and empire, particularly work examining quotidian sites – in this case, rural land use in the Canal Zone – where governmental techniques used to organize life were implemented, developed, and negotiated.[171] Access to land in the Zone was inextricable from the racial, cultural, and economic taxonomies constructed and reinforced by administrators. Access to a range of basic infrastructure – food commissaries, hospitals, housing, and transportation – turned on one's location in this

[169] Tsing 1993, 27.

[170] Bhaba 1989, Spivak 1987.

[171] Stoler 2001, Stoler and Cooper 1997.

taxonomy. What emerged in the case of rural land use, in particular, was a situation in which access to critical transportation infrastructure was embedded in political control. Agricultural products – especially a time-sensitive crop like bananas – had little value if passing trains did not stop and the boats of purchasers could not enter Canal Zone waters.

The chapter is organized in four sections. First, I retrace the historical extension of bananas and transportation networks together across Central America. Second, I examine the symbiotic relationship between transport and agrarian economies on the Panamanian isthmus prior to the initiation of the US Panama Canal project in 1904, foregrounding the role of banana production in sustenance during downturns in the transportation economy. This section highlights the rise and fall of banana networks around the Chagres River. Third, I describe debates around food, labor, and the agricultural possibilities of rural lands in the Canal Zone during the 1904-1914 canal construction period. This section foregrounds early tensions in the enclave around rural land use. Finally, the bulk of the essay examines transformations that took place after the Canal Zone was "thrown open" to agriculture in 1921, ushering in a banana boom that brought together actors pursuing diverse, but often overlapping, projects. I conclude by returning to my claim that the banana allows us to examine the history of rural landscapes in a manner that sheds a different light on the trajectory of the Panama Canal enterprise.

BANANAS AND THE MARGINS OF TRANSPORTATION NETWORKS

Botanists believe that the wild ancestor of the modern banana was domesticated in highland New Guinea around 5000 BC. Edible varieties spread across the Old World

tropics and accompanied European colonists as they arrived in the Caribbean.[172] In his *Natural History of the West Indies*, Gonzalo Fernández de Oviedo reported that bananas were introduced to the Americas in 1516. A decade later, the plants "…multiplied so greatly that it is marvelous to see the great abundance of them on the islands and in Tierra Firme where the Christians have settled."[173] Bananas were (and remain) plants of empire. The environmental historian Alfred Crosby has shown that colonial conquest was a collective effort by old world *portmanteau biota* (dominated by the European human) that evolved in conflict and cooperation.[174] The banana, a tropical perennial, was not technically part of temperate European invasive networks, but its corms (rhizomes) traveled with them, benefitting from and supporting the ecological reorganization of the neo-tropics. Bananas were a key subsistence crop for the slaves[175] and laborers who built transportation networks and worked on the plantations that supported extractive colonial, imperial, and post-colonial political economies in Central America and the Caribbean.

Why use bananas to think about governance and labor at the margins of the Canal Zone? The modern banana is sterile and rhizomatic. It depends on human labor and transportation networks for propagation and dispersal. This means that it thrives along

[172] Muller-Wille 2007.

[173] The introduction of the banana to the Americas has been and remains a contested history. Many contradictory statements appear in the primary and secondary literature. It is not my purpose in this chapter to enter this debate. For the most common account, referenced here, see Oviedo [1526] 1986. Gonzalo Fernández de Oviedo was the first to write on the banana in the new world. For an account of the banana introduction debate, see Langdon 1993.

[174] Crosby 1986.

[175] Carl Linneaus wrote in 1736 [2007] that Barbadian sugar plantation slaves were provided one to two bananas weekly. In a 2007 introduction to this work, Muller-Wille discusses the relationship among bananas, slavery, and the colonial plantation economy. He writes, "[Linneaus] overlooked in a typically Eurocentric and supremacist way the degree to which the plantation system depended on a well-developed subsistence and market economy among slaves." (2007, 28-29).

edge environments, particularly the borderlands where modern transportation lines and lowland tropical ecology meet. In both a technological and ecological sense, then, the Canal Zone provided an ideal habitat for bananas. But transportation networks are inextricable from the cultural and political institutions that they draw on and reorganize. The success of the banana depends on infrastructure, ecology, and socio-political priorities. For the governments of the so-called banana republic nations in Central America, including Panama, banana exports were often seen as a path to economic development. The Zone, by contrast, was a transportation enclave with very different governmental issues. For some white administrators, banana cultivation had positive associations (self-sufficiency and poverty relief), but, for others, the fruit had negative associations (black, unsanitary, backwards).

Let me explain how I became interested in understanding the histories of banana networks around the Panama Canal and Canal Zone. The prominence of the banana trade in oral histories of the region around the waterway initially surprised me. Before conducting ethnographic fieldwork in Panama in 2008 and 2009, I had never encountered in the historiography what the oldest villagers living along the banks of the waterway today call the era of green gold. *"To'o eso era puro guineo"* (this all used to be bananas), old Afro-Panamanian men wearing *guayabera* shirts reminded me whenever I asked about regional history. Ethnography and, later, archival work confirmed that during the 1920s and early-1930s, the banana export trade dominated landscapes and livelihoods around Gatun Lake, the canal's artificial storage reservoir.

In 1927, the height of the boom, the quantity of bananas produced regionally and shipped from Canal Zone ports reached nearly 2.8 million bunches, an increase of more than 1200% in five years. Although this figure did not approach exports from so-called banana republics,[176] led by Honduras, it was significant given the Canal Zone's limited area, predominance of smallholder production, and unique political configuration. During the banana boom, diverse groups – smallholder farmers, *compradores* (middlemen), state functionaries, and capitalists – came together to negotiate the production, transport, and sale of "green gold." A shared investment in bananas temporarily brought these seemingly disparate actors into negotiation with one another.

Bananas and Railroads Expand Together across Central America

During the late-19th and early-20th centuries, railroad lines were built across Central America and large swaths of adjacent forest cleared and planted with banana monocultures. The construction of transportation infrastructure and expansion of banana production were mutually reinforcing – even coextensive – projects. This connection is exemplified by the prominent origin myth of Central American banana capitalism. Minor Keith, like many of the banana capitalists of the period, entered the fruit trade via the shipping business. He came to Costa Rica from the US in 1871 to work for his uncle, Henry Meiggs, who was under contract with the national government to build a railroad between San Jose and the Caribbean port city of Limon, Costa Rica. Keith took over in 1877 after Meiggs passed away. When the Costa Rican government defaulted on

[176] The 2.8 million bunches from Canal Zone ports figure comes from Canal Record, Jan. 18, 1928; By comparison, Honduras, the top Central American producer, exported 29 million bunches in 1929. See Soluri 2005, 52.

payments and construction funds ran out in 1882, Keith offered his idle work force – predominantly black West Indians – small agricultural plots to cultivate along the tracks to keep them from abandoning the project.[177] He recruited heavily and successfully in Jamaica, after failed experiments with Chinese and Italian workers unwilling to endure yellow fever and malaria for low wages. Costa Rica later met its financial obligations by giving Keith 800,000 acres along the train route. His "discovery" was that the bananas his West Indian laborers grew for subsistence might become profitable freight for the unfinished railroad.[178]

The geographical development of the banana-railroad union varied across Central America. In Costa Rica and Guatemala, railroad lines were built between major cities and ports. Bananas followed the tracks after they were laid. With the financial success of initial banana exports, however, the process was often inverted elsewhere. In Honduras, railroad lines traversed fruit districts and left important cities disconnected. The territorial logic of banana exports shaped the orientation and distribution of railroad lines that were constructed to facilitate production and transport. It is not my intention here to develop – or revise – the increasingly sophisticated and transnational historiography of banana production, export, and marketing,[179] but to emphasize that transportation networks and banana production extended in tandem across the region. The key point is that the landscapes that emerged were neither technologically

177 Keith recruited migrant West Indian laborers because attracting local labor was a perpetual problem in Costa Rica. On this history, see, Chompsky 1996, 27 and Marquardt 2001, 53.

178 Koeppel 2008: 58-60.

[179] The spatial history of the early banana-railroad union in Central America is detailed in Kepner and Soothhill 1935, 155. Bananas have been a topic of a raft of recent academic and popular writing. For academic accounts, see Bourgois 1989, 1993, Grossman 2000, Soluri 2005, and Strifler and Moberg 2003. For popular accounts, see Jenkins 2000, Koeppel 2008, and Roche 1998.

preformatted (railroads producing homogeneous tropical space), nor geographically predetermined (reflecting "natural advantages"), but the hybrid products of a techno-ecological network extending across political, economic, and cultural difference. Guatemala was not Honduras. The Canal Zone was neither.

TRANSPORTATION AND AGRARIAN ECONOMIES ALONG THE CHAGRES RIVER

Panama's economic advantage, it has been widely asserted, is its geographic position. From colonialists to capitalists, path-builders have seen the isthmus – and, in particular, the Chagres River valley – as a space of connection, not agricultural production. Over the past five hundred years, interoceanic transportation has been enabled through large transportation projects (the Spanish colonial *Camino Real*, the Panama Railroad, and the Panama Canal) that require a large labor force, which the region historically lacked. Path-builders largely recruited laborers elsewhere, often in impoverished Caribbean locales. Consequently, periodic, large-scale in- and out-migrations of laborers has fundamentally shaped regional demography (Table 3.1). We commonly think of transportation networks as a critical infrastructure for agricultural development. However, in this transit zone, the inverse has been equally true: agriculture has supported the transport economy by providing sustenance for a past and future labor force through economic boom and bust cycles. Agriculture has a long history along the Chagres River and its tributaries, where smallholders have cultivated tubers, rice, fruits, and vegetables within swidden production systems for millennia. During the late-nineteenth century and early-twentieth century, the social boundary between transport and agrarian economies was permeable. The ethnically and culturally heterogeneous

population that North Americans glossed as "natives" moved periodically between wage labor and farming as regional socio-economic conditions changed.

Table 3.1: Estimated Population of the Chagres River Watershed, 1790-1896[180]

Year	Population	Density (people/km)
1790	1,500	0.5
1851	2,000	0.6
1896	20,000	6.0

Banana production, for export and subsistence, was a means of mitigating the livelihood risk associated with the transport economy during the late-nineteenth century. When the Chagres River region was enclosed within the Canal Zone in 1903, smallholders in the region had intermittently participated in international banana markets for nearly forty years.[181] In fact, they grew some of the first bananas exported to North America. In 1866, Carl Franc, a steward for Pacific Mail Steamships, entered an agreement to ship bananas from Aspinwall (later renamed Colon) to New York City.[182] Aspinwall was the Caribbean terminus of the new Panama Railroad – built between 1850 and 1855 – and a port city. In a development that foreshadowed Minor Keith's "discovery" of banana production in Costa Rica, Franc recognized that banana exports thrived under the social, technical, and ecological conditions along the Chagres River.

Frederick Adams, United Fruit Company historian and eulogist, wrote of Franc and company, "They had preempted the only known spot in the American tropics where

[180] Suarez 1987, 137.

[181] Reynolds 1927, 40-41.

[182] Adams 1914, 35.

it seemed safe to raise and export bananas. The great stream of the world's commerce beat up against Colon. The Panama railroad was in operation, and the demands of international trade automatically decreed that peace and order should prevail in the territory adjacent to that natural pathway of commerce."[183] He was correct, in an obvious sense. The plants flourished in the rich alluvial soils along the line and their fruits could be easily transported to port in Colon via the railroad. But this framing neglects the marginalized human communities that made banana exports possible. Thousands lives were lost building the region's roads, railroads, and waterways, making this far from a "natural pathway." Among the region's principal economic advantages in the 1860s were the numerous unemployed former railroad laborers – whose numbers reached an estimated seven thousand during construction – who might be mobilized for banana production. According to historian Lancelot Lewis, "Completion of the railroad in 1855 left many laborers stranded on the isthmus of Panama. Some settled and prospered in the larger cities of Colon and Panama City…many resumed their rural way of life in the interior towns of the country and through their efforts the agricultural production of the republic increased rapidly."[184]

The village of Gatun – the first Panama Railroad stop traveling south from the Caribbean – was the hub of the rural banana trade, but North American travelers saw only a marginal community and a historical footnote. Historian F.N. Otis wrote, "[T]he ancient native town of *Gatun*, which is composed of forty or fifty huts of cane and palm, and situated on the edge of a broad savanna that extends back to a range of hills a mile or

[183] ibid., 38.

[184] Lewis 1980, 19-20. See also Anguizola 1968, 352.

two distant. The place is worthy of mention as a point where, in the days by-gone, the bongo-loads of California travelers used to stop for refreshment on their way up the river..."[185] Within the riparian social world that stretched along the banks of the Chagres and its tributaries, however, the town occupied a prominent position. The intimate economy of the diverse *Gatuneros* – "few whites, many mulattoes, but blacks predominated"[186] – revolved around transportation, but became increasingly linked to the nascent banana trade after the completion of the railroad in 1855. Smallholders arrived by river one day each week from farms in the vicinity in long wooden canoes stacked high with bananas. From Gatun, bananas were shipped to Aspinwall and loaded on steamers bound for the eastern US. Franc's Aspinwall Fruit Company flourished during the late-1860s and 1870s, the period of economic decline between the end of the railroad construction and the French canal project.

Exports from Gatun practically ceased when, in 1881, the French Canal Company began paying wages high enough to motivate banana farmers to abandon their fields around the Chagres River and as far as Costa Rica.[187] Farmers returned to bananas after the failure of the French project. As late as 1904, Panamanian officials reported that the village of Gatun continued to participate relatively heavily in the banana trade.[188] Seven to nine railroad carloads of bananas were shipped from town weekly. But that same year, transportation construction took center stage again as the US Panama Canal project

[185] Otis [1861] 1971, 81

[186] Tejiera [1962] 1995, 74.

[187] Reynolds 1927, 40-41; Roberts [1932] 2006, 200.

[188] There is support for this in oral histories collected around the lake in Heckadon-Moreno 1981, 6-12; See also Government of Panama 1905.

began. Gatun persisted a few years as a regional trading center, but farmers abandoned their fields for wage labor. The town was relocated to higher ground in 1908 in anticipation of the flooding of a water storage reservoir – Lake Gatun – for the future canal.[189]

THE "AGRICULTURAL POSSIBILITIES" OF THE CANAL ZONE

On November 15, 1909, US soil scientist Hugh H. Bennett and horticulturalist WA Taylor arrived in Panama to conduct field investigations on "the climate, soil, crops, and other conditions bearing upon the development of agriculture in the region bordering the canal."[190] The scientists were sent to the isthmus at the request of Chief Engineer George Goethals, who had appealed to the United States Department of Agriculture for expert assistance in assessing the possibilities for agriculture and food production within the Canal Zone.[191] Bennett and Taylor described the food supply in 1909: "Canned fruits, vegetables, fish, meats, and butter are largely used, though these more perishable products are supplied in large quantities in the fresh state from the United States. This is accomplished by shipment in refrigeration from New York and New Orleans to Colon, at which point such articles as require it are placed in cold storage, where they are available for daily distribution by supply trains across the isthmus as required."[192]

Feeding an enormous labor force had been a persistent problem for administrators intent on completing construction. Delivery logistics – moving calories in bulk from

[189] See Canal Record April 8, 1908.

[190] Bennett and Taylor 1912, 2.

[191] George Goethals to Secretary of War, June 22, 1909, NACP RG 185, Entry 30, Folder 33-D-37(1).

[192] Bennett and Taylor 1912, 39.

agricultural areas to construction sites – was only one aspect of the food problem. Food consumption was also shaped by the diverse cultural backgrounds of the work force. Workers ate in mess halls and paid for meals with coupons that cost 30 cents each.[193] Despite the availability of affordable meals in mess halls, West Indian laborers were reluctant to spend wages on food and skimped on eating to save money. This alarmed administrators concerned about the productivity of the largest population in the labor force. Laborers' relationship with food was irreducible to money. West Indians, in particular, were accustomed to growing food in their own garden plots, an option not available to them in the Canal Zone.[194] For white North American employees, by contrast, food problems often revolved around quality and nutrition. "Too much canned food and solid diet is being used at the present time," the Chief Sanitary Inspector wrote Colonel William Gorgas, head of the Department of Health, in 1906, "Green vegetables are very scarce and high priced at most places in the Canal Zone, and at many places cannot be had…I am also informed by various District Physicians that it would be very advantageous for the physical condition of the ICC [Isthmian Canal Commission] employees and laborers to have sufficient vegetables available at a reasonable price so that the employees would not be compelled to use canned stuffs daily."[195] His call for local food production would become ironic because, in subsequent decades, the Department of Health would become the most vocal critic of agriculture in the Zone.

[193] AS Hitchcock to FV Coville, Botanist in Charge of Taxonomic and Range Investigations, Aug. 28, 1911, SIA, United States National Museum, Division of Grasses, Records, 1884, 1888, 1899-1965, RU 229, Box 11, Folder 1.

[194] Richardson 1985, 197.

[195] JA LePrince, Chief Sanitary Inspector, to WC Gorgas, Chief Sanitary Officer, Jan. 30 1906, NACP RG 185, Entry 30, Folder 33-D-37(1).

Five years into the canal project, rural land use was emerging as a highly politicized issue in the Zone. Goethals expressed enthusiasm about the potential for the agricultural development of lands away from townsites and canal installations in a letter to the Secretary of War. "These lands," he wrote, "derive practically their entire value from their agricultural possibilities."[196] But he and other administrators also questioned whether agriculture was a suitable use of canal appropriations. In a letter written that same day to a subordinate in Panama, he expressed ambivalence about agriculture as it related to the still undefined parameters of the canal project and concluded that it was too tangentially connected with construction to be funded, but should nevertheless be handled with care. "[A] sentimental interest attaches itself to the development of the agricultural possibilities of the Zone that must be taken into consideration," he explained, "and if we dropped this work entirely it would put us continually on the defensive and possibly subject us to some unfavorable criticism."[197] Goethals recognized, presciently, the powerful moral-economic force located at the nexus of food, agriculture, and labor.[198]

Early efforts to develop Canal Zone agriculture proceeded, haltingly, through horticultural experimentation and land lease programs. The first working horticulturalist in the Canal Zone, Henry Schultz, was hired by the Department of Health upon the recommendation of Department of Agriculture "plant explorer" David Fairchild in

[196] Goethals to Secretary of War, June 22, 1909, NACP RG 185, Entry 30, Folder 33-D-37(1).

[197] Goethals to Major Milson, Subsistence Officer, June 22, 1909. NACP RG 185, Entry 30, Folder 33-D-37(1).

[198]The classic formulation of moral economy is in EP Thompson 1971. He suggests that food riots in eighteenth century England should not be explained through "an abbreviated view of economic man." People participated in food riots, he argues, not simply because they were hungry, but because they were "informed by the belief that they were defending traditional rights and customs…that they were supported by the consensus of the community." (1971, 78).

1906.[199] Schultz began work as a landscape gardener on the grounds of the Ancon Hospital. As his title and department suggest, his work was not agricultural development. There was limited support for agriculture in the Department of Health – which emphasized the creation of sanitary, "homelike" landscapes around buildings in Zone communities.[200] Schultz was transferred to the Department of Labor, Quarters, and Subsistence – the department charged with feeding and housing the workforce. The Chief Quartermaster, his new boss, wanted to experiment with gardens near townsites that would supply fresh vegetables – tomatoes, cucumbers, beans, eggplants, okra, radishes, and lettuce – recognizable to North American residents, but the gardens received limited institutional support. Whereas "healthy landscapes," associated with manicured lawns, ornamental plants, and an absence of mosquitoes, were seen as vital to the well-being of white employees from the temperate zone and, thus, an appropriate use of canal appropriations, vegetable gardens were seen as increasingly unnecessary as fresh foods from the US became more readily available due to changing transportation and refrigeration technologies.[201] The Isthmian Canal Commission allowed its gardens to go fallow until receiving Bennett and Taylor's recommendations on the agricultural possibilities of the Zone.

The United States Congress authorized the first public land lease program in the Canal Zone in February 1909. The impetus was to develop a policy that would motivate

[199] David Fairchild, United States Department of Agriculture Agricultural Explorer in Charge, had an active and long-term interest in the development of horticultural work in the Canal Zone. See his correspondence with Zone horticulturalists in Record Locator 185, Entry 30, Horticultural Work on the Isthmus, Folders 33-H-3; and also Entry 34, Folders 33-H-3.

[200] Henry Schultz, Landscape Gardener, to JA LePrince, Chief Sanitary Inspector, Sept. 5 1907, NACP RG 185, Entry 30, Folder 33-H-9(1).

[201] See NACP RG 185, Entry 30, Gardens – Operation by the Panama Canal, Folder 33-H-9(1)

private individuals to take the initiative for agricultural development. "There is a general opinion," Goethals concluded, "[that] with proper instruction and information lease holders should be able to secure sufficient returns to make the cultivation and settlement of the Canal Zone very attractive."[202] His opinion was not universal. Invoking a determinist discourse that conflated tropical fecundity and racialized laziness, Subsistence Officer Eugene Wilson wrote, "[T]he permanent population of the Canal Zone does not desire to be educated and has no interest in agricultural pursuits whatever. Agriculture cannot be stimulated in a population whose sole desire is to accumulate a dozen bananas, two quarts of rum and a bolt of calico and then call themselves merchants."[203] The land lease program was on the books, but leases remained unavailable. Ironically, for a region that had been heavily surveyed for decades, there was still no triangulated, accurate map. Three maps had been made, wrote engineer W.B. Nichols to Goethals, but "no two…will probably agree in distance between prominent points."[204] Thus, the lands and peoples of the rural Canal Zone were poorly known and mapped when Bennett and Taylor arrived in November 1909 to conduct the anticipated survey on the agricultural possibilities of the region.

"In so far as the Canal Zone is concerned," Bennett and Taylor wrote, "the total present crop production barely supplies the simple needs of the scattered rural population."[205] They identified important agricultural features of the region as follows:

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[202] Goethals to Secretary of War, June 22, 1909, NACP RG 185, Entry 30, Folder 33-D-37(1).

[203] Eugene Wilson, Subsistence Officer, to George Goethals, Aug. 19, 1909, NACP RG 185, Entry 30, Lands of Canal Zone – Agricultural Possibilities, Folder 33-D-37(1)

[204] This, they wrote at the time, was because past surveyors used waterways as stable points of reference, when the rivers were always changing course.

[205] Bennett and Taylor 1912, 39.

humid tropical climate, broken topography, clayey soil, production dominated by mixed, migratory cropping, a population dominated by Panamanians and West Indian laborers, and public lands held by the US government that could not be titled. Regional agriculture was "confined mainly to the meager efforts of the native and West Indian population and they are restricted to patch farming."[206] Smallholders reportedly practiced "migratory cropping" with machete and sharpened stick on one-half to two acre plots, neither plowing nor rotating crops. For Bennett, such "primitive" techniques were a natural outcome of the bounty and enervating effects of the tropical climate. "The native," he wrote, "is an independent person who is not always ready to work, even for the best of wages, because of the contentment he finds upon his small clearing in the midst of sufficient fruits and vegetables to meet the food requirements of his family, with a small surplus for providing the few additional wants."[207] What Bennett and Taylor did *not* see when they arrived on the isthmus was the banana export economy that had thrived around the Chagres during the previous half-century. They encountered a rural landscape emptied out by another transportation construction boom. By 1909, the regional banana networks were nearly dead – or, more accurately, dormant. This transformation would have shaped the agricultural production the experts described in their 1912 report "The Agricultural Possibilities of the Canal Zone."

"The most promising line of attack upon the agricultural problem of the Canal Zone" the scientists concluded, "will apparently be to develop a permanent mixed tropical agriculture with a distinct horticultural trend, in which hand labor of tropical

[206] Bennett and Taylor 1912, 11.

[207] Bennett and Taylor 1912, 20.

origin will be the main dependence for tillage. [It should] favor the production of high-priced products requiring regular and frequent transportation service, such as will doubtless be available promptly after the opening of the canal for use."[208] The other service that promised to be abundantly available after construction ended, they recognized, was West Indian labor. Bennett and Taylor identified West Indians as more industrious agriculturalists than Spanish-speaking people.[209] Indeed, they were relatively optimistic about West Indians' production potential under "competent supervision." "[A] considerable part of the population of this character could maintain itself on the products of the soil if either encouraged or permitted to remain when the completion of the canal ends the need for labor on construction work."[210] Indeed, the question of rural governance – would laborers be permitted to farm the Zone after construction? – and unresolved future uses for these lands distinguished them from others adjacent to transportation in Central America.

THE CANAL ZONE "THROWN OPEN" TO AGRICULTURE

The Panama Canal opened in August 1914, during the beginning of the First World War. The war precipitated a global economic recession compounding an already dire employment situation in Panama. The canal labor force peaked the previous year at 56,654 laborers, one-third of an estimated 150,000 total employed during construction.[211] With construction complete, only a small portion of the massive labor force was still

[208] Bennett and Taylor 1912, 47.

[209] The region's historical demography, defined by immigration and emigration, render stable definitions of "native" problematic.

[210] Bennett and Taylor 1912, 46.

[211] Conniff 1985, Suarez 1998.

needed. In 1914, the Isthmian Canal Commission laid off an astounding thirty-eight thousand employees. Between 1914 and 1917, approximately thirteen thousand West Indians accepted free trips home courtesy of the US government.[212] Others migrated elsewhere in Central America, many to work at company-run banana plantations. But most Caribbean migrants – an estimated forty-thousand to fifty-thousand – remained. Moreover, people continued to arrive from the Caribbean, where the economy was even worse than Panama's.[213] There were few jobs and wages were lower for the employed. Economic, racial, and class tensions were on the rise in Panama City and Colon. As urban populations grew, the rural lands of the Canal Zone remained depopulated, as they had been for a decade. West Indian leaders campaigned to have them opened to agriculture to mitigate the effects of unemployment. Reverend S. Moss Loveridge, a black Baptist leader, pleaded with Governor Chester Harding to open the Zone to agriculture:

> Just now, when in the United States and Europe, so much stress is being laid on the question of intensive cultivation, and when the soldier makes preparation for any possible eventuality it seems to me that – (a) With tens of thousands of acres of uncultivated land on the Isthmus. (b) With thousands of unemployed at the present time in the cities of Colon and Panama, both of the 'out-of-work,' and 'won't work,' classes. (c) With the present organization and agricultural experts of the United States Government on the Isthmus. (d) With the planting season just before us, and (e) Cooperation between the Governments of the United States and Panama; That it would be a splendid opportunity to utilize the idle labour and idle land, if the United States would furnish the appropriation to cover same, and if necessary conscript all unemployed labor for the purpose of placing the Isthmus, with its present military and civilian population, a long way towards becoming self-supporting so far as vegetables, fruit, etc., are concerned.[214]

[212] Conniff 1985, 46.

[213] According to Peter Clegg (2002, 34), the Jamaican banana trade had been devastated through the cumulative effects of drought, hurricanes, and war during this period.

[214] Reverend S. Moss Loveridge, Honorary Chaplain Canal Zone Mission Churches, to Chester Harding, Governor of the Panama Canal, May 4, 1917, NACP RG 185, Entry 34, Folder 33-H-9(2).

Resettlement was considered in earnest in the wake of a massive worker strike in 1919, before an additional 5,500 employees were laid off.[215] Proponents within and outside of the Canal Zone government argued that an agricultural land lease program would reduce mounting agitation on the isthmus, establish a labor reservoir that could be tapped for future canal work, and provide better food for employees.[216] This was along the lines that Loveridge and others had argued for some time and also replicated the flow of laborers between transportation and agriculture in previous decades and centuries. It was within this charged context that, in 1921, the US Secretary of War appointed a commission to investigate and make recommendations related to the future of the Panama Canal. Their report recommended that the Canal Zone be reopened to agriculture

Since 1912, depopulation had been the official Canal Commission policy towards rural Canal Zone lands. Governor Jay Morrow expressed dissatisfaction with the mounting pressure to allow West Indians – whom he considered ignorant, lazy, and myopic – to populate the rural Canal Zone. "These people have no money to put up proper houses or to do any proper cultivating," he wrote, "and I would be reluctant to see the Canal Zone again covered with the unsightly and unsanitary shacks which once existed in the neighborhood of all Canal Zone towns."[217] Nevertheless, in October 1921, he received instructions from the Secretary of War to implement the policy. The land lease program would "throw open" rural lands to agriculture. Land leases would be restricted to former canal laborers, largely West Indians, excluding most Panamanians.

[215] Conniff 1985, 55.

[216] RK Morris, Quartermaster, to Jay Morrow, Governor of the Panama Canal, Sept. 7 1921, NACP RG 185, Entry 34, Folder 33-B-51(2A).

[217] Jay Morrow, Memorandum to General Connor, 11 July 1921, NACP RG 185, Entry 34, Folder 33-B-51(2A).

This restriction reflected the fact that the main objective of resettlement was not agricultural development, but the placation of an unemployed and potentially unruly labor force. It also echoed Bennett's call for providing preference to "industrious" West Indian farmers. Governor Morrow curtly denied a Los Angeles man who inquired about a lease for banana production: "[T]he provisions of this circular were not intended to apply to non-residents. Owing to reductions of force on the Canal, there were congregated in the cities of Colon and Panama in the Republic of Panama a large number of West Indian ex-employees who were without means of subsistence and dependent on charity; and the policy of allowing settlement on small plots of land in the Canal Zone was inaugurated for their relief. The land in the Zone is suitable for the cultivation of bananas and other tropical fruits, but it would not be wise for an American to come here for that purpose, and our relations with the Republic of Panama are such that settlement on the Zone by non-residents for extensive agricultural operations could not be permitted."[218]

The land lease program inverted agricultural development projects in the Republic of Panama. Under President Belisario Porras, the Liberal government gave massive concessions to European and North American capitalists in the rural interior in exchange for commitments to build transportation networks and employ rural people. Bananas, more than half of the nation's exports, were central to this initiative.[219] But extensive private farming was not politically tenable in the Canal Zone given mounting tensions

[218] Jay Morrow, Governor, to WH Marker, April 10, 1922, NACP RG 185, Entry 34, Folder 33-B-51(3).

[219] Libro Azul of Panama 1917, 65. In 1914, bananas comprised 65% of Panamanian national exports.

between the US and Panama over appropriate land use around the waterway. Paradoxically, the valuable agricultural lands at the margins of this archetypal modern project would be distributed almost exclusively to West Indian smallholders.

Latent Banana Networks are Revived on Gatun Lake

The terms of the lease program were excellent for former canal laborers: no rent for the first two and a half years, free treatment in Canal Zone hospitals for seven years, and free home construction materials.[220] One newspaper columnist wrote, "the bushman had been allowed to come back to his native habitat."[221] But, in reality, both "bushman" and "habitat" were quite different. Most of the new lessees were foreign-born: 87% of the nearly nine hundred leases were awarded to West Indians during the first six months of the program.[222] If the lessees were largely new to Panama, they were not new to bananas. Many of the West Indian settlers had previously worked in commercial banana cultivation in the Caribbean or elsewhere in Central America.[223] Here, as elsewhere, their intimate knowledge facilitated the reestablishment of latent banana networks. The rural Canal Zone landscapes they encountered in 1922 might have been unrecognizable to someone who had lived along the Chagres River when the US first arrived. The riparian bottomlands farmed by previous generations of banana producers were now beneath the green waters of Gatun Lake. Former hillsides and hilltops had become the lakeshores and islands that gave form to the lacustrine world. The terrestrial landscape was also

[220] NA Becker, Land Agent, to Engineer of Maintenance, Panama Canal, May 3, 1932, NACP RG 185, Entry 34, Licensing Land in CZ for Agricultural Purposes, Folder 33-B-51(8),

[221] Ben, May 9, 1926, "Ruminations of an Old Timer," Panama Times, 9 May 1926.

[222] CA McIlvaine, Panama Canal Executive Secretary, to Constantine Graham, British Charge d'Affairs, Panama), Aug. 16 1922, NACP RG 185, Entry 34, Licensing Land in CZ for Agricultural Purposes, Folder 33-B-51(4),

[223] Marquardt 2001, 55.

changed. Following the depopulation policy of 1912, secondary forest cover increased dramatically.[224]

According to Tomas Ramos, whose father was a farmer on the lake, the story that unfolded when the lands were opened to settlement was yet another iteration of a ubiquitous process of smallholder banana colonization. "*Subió la fiebre del banana de nuevo* [the banana fever arose again]," he explained to me,[225] almost impatiently. "When the settlers came, they said, 'One can plant bananas here. Here is the lake, and there are forests nearby to cut and replant with bananas, too. They won't have to be carried far, only cut down and thrown in the canoe.' So that's how they started to sell bananas and drink *aguardiente* [sugar cane alcohol] and live easy."

Even as transportation within the terminus cities and contiguous Canal Zone was channeled by a growing system of roads, the hundreds of square miles between remained an aquatic space dominated by canoes, launches, lighters, and the Panama Railroad – which ran over a raised causeway that split Gatun Lake. Canal Zone bananas circulated over a heterogeneous transportation network that linked white and black, English and Spanish, rich and poor, modern technology and machete, and, eventually, tropical and temperate climates. "Everybody was planting, and everybody expected to make from 50 to 100 per cent on the investment," one journalist recalled. "More than one prospectus was issued describing bananas as 'green gold'."[226] Participants in the diverse community

[224] The extent of pre-construction forest cover is unclear, but there are accounts of the remains of old farms being found within the secondary forest that grew up across the rural Canal Zone after the depopulation order of 1912.

[225] Valerio Ramos, interview with author, Salamanca, Panama, Nov. 7, 2008,
[226] Panama American, July 1, 1927.

of practice that came together around the production, transport, and sale of bananas shared a terminology, body of knowledge, and set of concerns.

By 1925, nearly all of the available Canal Zone land with river or lake access had been leased and planted in bananas.[227] Old men and women in the small towns around Gatun Lake still remember the banana boom years fondly as the most prosperous of the century.[228] Bands of musicians traveled around the lake, playing a night or two in each town. People had cash to buy necessities from the store, but still planted subsistence plots of corn, rice, plantains, and various root crops alongside their small banana plantations. Local bananas became, once more, global commodities. Reviving a regional practice that dated to banana markets in the flooded town of Gatun decades before, lakeside communities held at least one weekly market day. Smallholders that farmed nearby would cut enough bunches – often fifteen to twenty – to generate the cash necessary for the week, while usually leaving enough to ensure some for the following week. Despite the proximity of most farms to waterways, the trip from plant to market was not easy. Wrapped in leaves so they would not bruise – after all, buyers would not accept bruised bananas – people carried bunches on their backs to a canoe. In lake villages, these buyers might arrive to find as many as a hundred canoes lined up with fruit to sell.

The term "green gold" did not apply to just any banana, but to a standardized fruit that could be transported to and marketed in North America. Picked green and sold to

[227] Canal Record, July 23, 1924

[228] Archival accounts of the lives of banana producers and land lessees are scarce, so in the paragraphs that follow, I draw on oral histories provided by their descendants. These interviews were conducted during 2008 and 2009 in two rural communities that were former hubs of the early-twentieth century banana trade and in communities situated in the above river system, which sold bananas downstream on the lake.

temperate consumers yellow, *Gros Michel* bananas for export had to be unbruised and seven to ten "hands" in size. Standards shaped the manner in which people interacted with bananas, one another, and the world beyond the lake. One woman told me that, at the time: "The people didn't eat [export] bananas. If you saw a person eating a banana you'd say 'pig'! You'd criticize the person…the *gringos* bought bananas to bring to the United States because they were worth a lot of money." The fruit allowed marginalized actors to access a global – or, better, globalizing – transportation network that extended out from the Panama Canal. But that access was contingent on their recognition by Canal Zone authorities as legitimate users of those networks and adjacent land.

Smallholders dominated production around Gatun Lake and banana capital was embodied not by large companies but local *compradores* – middleman buyers – whose launches towed flat-bottomed lighters around the banks of the lake. Typically independent contractors, *compradores* mediated the relationship between banana companies and smallholder producers. Their influence within this network was multi-directional. On the lake, they provided start-up loans to small farmers to hire laborers to clear the forest with machetes and plant bulblike corms (a few cents each). The first crop of *Gros Michel* bananas, harvested as little as eleven months after planting, was usually the best, producing the large bunches desired by foreign companies and consumers. Nothing less than seven "hands" would be purchased. Banana standards were significant in negotiations between farmers and *compradores*: it was not uncommon for farmers to be unable to sell the fruit they had cut, carried, and canoed to market due to quality issues. In practice, standards were malleable and negotiated, depending as much on the

farmer as the bananas. A 1935 description of Standard Fruit's buying practices resonates with oral histories of Canal Zone banana negotiations.

> No matter how conscientious an individual inspector may be, it is hard for him not to be influenced, consciously or unconsciously, by various psychological factors in drawing the fine distinction between good and bad quality or between one grade of maturity and another. When the company is clamoring for more fruit, or when a planter influential in politics is concerned, the inspector tends to be more lenient than usual in inspecting the fruit. Sometimes, however, there is more available fruit that the steamer at the dock can carry, or market prices are dropping and a sizzling radio message arrives from Boston, saying, 'Reduce your cargoes,' or 'Ship only good fruit.' Then the tropical division manager and his superintendent of export, who do not want to be blamed for payments for large quantities of fruit that the company prefers *not to accept and market*, check up the inspectors, who often work 18 to 24 hours at a stretch, ordering them to be especially careful not to receive any but 'the best fruit.'[229]

One man, known as the Banana King of Panama, exerted disproportionate power over banana networks on Gatun Lake in the early-1920s. John "Johnnie" Walker arrived in Panama from the US around 1907 – the early years of canal construction – intending to explore the country's commercial possibilities.[230] He first worked in the lumber trade, selling mahogany and other trees harvested in Panama within the Canal Zone. By participating in this business, he recalled, he came to understand the "natives of the little jungle towns…their problems, their life, and their feeling." Walker was the embodiment of the North American managerial type that Bennett and Taylor believed would make agriculture successful on the isthmus – transforming labor, soil, and rain into profit. In a 1925 newspaper profile, he was credited with establishing the regional banana industry "on a successful, business-like status…justifying the hopes reposed in soil and

[229] Kepner and Soothhill 1935, 266-267

[230] Feeney 1925.

climate."[231] He owned and operated a plantation in Panama – outside the Canal Zone – that had access to the western shore of Gatun Lake. He paid his laborers by "piece work or hourly, in some cases, for no one but a theorist would ever think of paying a Central American native or West Indian help by any other contract." The natives, he explained, have little use for paper money, but were "buying $15.00 shoes and tailored clothes" after Walker "taught" them how "to grow bananas in quantities to sell."[232] He also made loans to smallholders to cover input costs. By operating a plantation and trading posts in nearby villages, Walker embodied the strain of intimate, paternalistic capitalism briefly controlled much of the banana traffic on the lake, but changed as more powerful capitalists attempted to exert control across the region.

In 1922, when the land lease program began, only one company – The Panama Railroad Steamship Line – shipped regional bananas from the Canal Zone to the Colon port. The Panama Railroad, unlike many banana exporters in Central America, focused on transportation and was not directly involved in production. Regional exports amounted to a humble eight thousand to nine thousand bunches monthly.[233] At the time, the only mature plantations in the region were located beyond the Canal Zone boundary in Panama. But this changed rapidly. In April 1922, the United Fruit Company began

[231] ibid.

[232] Temperate zone settlers in Panama persistently recognized the problem of disposing rational economic conduct among peoples they judged understood to be unmotivated by capitalist accumulation, or, put another way, "lazy." Scholars have explored this tension empirically along the spatio-temporal margins of capitalism, particularly historians of the industrial revolution in Europe. It has also been a key problem in social theory. Michael Taussig writes, "The first reaction of such persons to their (usually forced) involvement in modern business enterprises as wage workers is frequently, if not universally, one of indifference to wage incentives and to the rationality that motivates homo oeconomicus. This response has time and time again frustrated capitalist entrepreneurs" (Taussig 1980, 19.) This resonates with discussions of economic man in Weber [1958] 2003, 54-72 and Foucault 1999.

[233] Canal Record, Nov. 28, 1923.

shipping bananas from Colon to New York weekly. A year later, after the first Zone land lease bananas were harvested, they shipped twice weekly.[234] United Fruit was both the world's largest banana company and its largest agricultural enterprise. In the 1920s, the company was transitioning from buying mainly from private producers to integrated company production. More than 60% of its fruit was purchased by "smaller" planters, ranging from West Indian smallholders to larger foreign and domestic capitalists.[235]

Johnnie Walker was the company's main buyer in the Gatun Lake district. In 1924, he traded twelve hundred to fifteen hundred bunches weekly.[236] At the time, both United Fruit and smallholders around the lake depended on *compradores* as mediators for their ability to align the goals and perspectives of diverse human communities. After all, the social worlds that bananas brought together around the Panama Canal possessed, in the words science and technology scholar Susan Leigh Star, "mixed economies of information with different values and only partially overlapping coin."[237] Nevertheless, the company did not like the power that Walker exercised on the lake. In a letter to United Fruit headquarters in Bocas del Toro, Panama, DO Phillips concluded, "…it is out of the question for Mr. Walker to control the production in Gatun Lake Region."[238] Phillips went on to suggest that the company buy directly from producers, cutting out Walker and independent *compradores*. He also argued that they strengthen their position

[234] United Fruit Company General Agent, Cristobal, to Jay Morrow, Governor, Panama Canal, Nov. 17, 1923 NACP RG 185, Entry 34, Bananas – Culture and Production in the Canal Zone and Vicinity, Folder 33-H-5(1),

[235] Marquardt 2001, 54.

[236] Feeney 1925.

[237] Star and Griesmer 1989, 413.

[238] Bourgeois 2003.

vis-à-vis competing companies on the lake by buying less mature fruit and locking producers into contracts. The idea was that, by purchasing fruit less mature than the standard export banana, they would undercut *compradores* and break their connections with producers.

By the end of the first year of the land lease program, 1923, the quantity of bananas destined for the Colon port continued to increase, overwhelming available transportation infrastructure. The Panama Railroad did not have enough dedicated banana cars to handle shipments.[239] In October 1923, perhaps as a response to transportation problems, small boats carrying bananas from the lake began to pass through the Gatun Locks for the first time.[240] In addition to land lease bananas coming to market, the Panamanian government gave concessions of thousands of hectares to capitalists who promised to plant bananas, build roads, and employ Panamanian laborers. Spanish-speaking farmers from the province of Cocle, to the west, began to migrate seasonally to work as banana laborers.[241] Two new export companies – San Blas Development Corporation (owned by Standard Fruit) and American Banana Company – entered the fray as the rural landscape was being transformed. Smallholders cultivated forested, sparsely populated lands located farther and farther up the Chagres River and its tributaries. The number of bananas exported from the Gatun Lake region doubled almost every year between 1922 and 1925.[242] By 1925, the Panama Railroad had dedicated entire trains two to three times every week to transporting bananas purchased on Gatun

[239] 17 May 1923, Record Locator 185.34.33.h.6, NA2.

[240] Canal Record, Nov. 7, 1923.

[241] Suarez 1981, 126.

[242] Canal Record, Jan. 20, 1926.

Lake.[243] That same year, United Fruit brought the first steamer to buy bananas on Gatun Lake – a practice previously forbidden on Panama Canal waters – cutting the train and *compradores* out of the network.[244] This, combined with continued efforts to lock smallholders into contracts,[245] fit the company's strategy of squeezing the middlemen off the lake. Regional growers were concerned about the growing power of the three big banana companies, and particularly suspicions of price-fixing arrangements. The Panama Fruit Growers Association was organized to help independent growers with marketing. The banana companies, whom the producers accused of price-fixing, responded with counter-accusations. They argued publicly that producers played them one against another in negotiations and also failed to honor contractual agreements.

Figure 3.1: Banana corm (rhizome) on a farm near the Panama Canal today.

[243] Canal Record, Jan. 28, 1925.

[244] Canal Record, July 8, 1925.

[245] Star and Herald, Feb. 24, 1924.

Even as production continued to increase, there was a sense that the end of the boom was approaching. Anxiety began to snowball when, in January 1926, regional newspapers announced the "arrival" of *Fusarium oxysporum*, a fungal pathogen that had decimated plantations elsewhere, at Gatun Lake. The Panama American newspaper reported, "There is reason to believe that the banana growers about Gatun Lake are in a pessimistic mood. There has been no falling off as yet in total production, and there may be none for some time to come, but the blight is spreading rapidly, and various planters who expected large returns on their investments will now be satisfied if they ultimately recover what money they expended."[246]

The first visible symptom of the infection – commonly referred to as Panama Disease, but called "banana blight" at that time around Gatun Lake – was the yellowing of the oldest leaves, followed by a wilt and buckling of leaves at the base. As the disease persists, younger leaves wilt until the entire plant is covered in dying leaves. The plant may buckle near the stock, or pseudostem[247] Panama disease does not immediately devastate the plant, but decreases the quantity and quality of the fruit produced. By the late-1920s, the disease had devastated the Panama's large Atlantic plantations to the point that production ceased completely. [248] The plantation model facilitated the expansion of the epidemic in two ways. First, the soil-borne fungus remained isolated as long as plants – and plantations – were not located directly next to one another. The transformation of landscape mosaics into banana monocultures enabled it to spread more easily locally. Second, the flow of rhizomes across the extensive transportation infrastructure of banana

[246] Panama American, Jan. 23, 1926.

[247] http://www.plantmanagementnetwork.org/pub/php/management/bananapanama/

[248] Marquardt 2001, 49.

companies allowed *Fusarium oxysporum* to leap between countries and ecosystems. Companies establishing large banana plantations in new areas would routinely import hundreds of thousands of rhizomes from production zones in other countries.[249]

Fusarium oxysporum was probably not a new arrival in Panama. It probably existed in some of the soils of the riparian bottomlands cultivated along the train line in the late-nineteenth century. But many of the lands cultivated during the 1920s – former hilltops and hillsides that became islands and banks – were marginal agricultural land before Gatun Lake was flooded, so farms were often in new locations. Nevertheless, the distribution of the fungus accelerated through the 1920s as banana monocultures came to dominate the regional landscape and disparate soils were biologically interwoven through inter-farm corm transfers. As an infrastructural species, the banana was threatened by the very socio-technical system that had enabled its widespread dispersal and propagation. The historical flow of corms within the Canal Zone is difficult to retrace, but a 1926 advertisement in the *Panama Times* offering 2500 hectares of titled, "Virgin Banana Land" near the lake provides a clue. [250] For the purchaser of the tract, corms would be "cheaply and conveniently obtained" locally. One producer recognized this as a problem, attributing the blight to "certain unscrupulous parties operating on the Lake [that] sold suckers from old diseased plantations to unsuspecting planters, and widely spread the blight."[251]

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[249] Minor Keith purchased the corms that he initially used in Costa Rica from Carl Franc's plantations along the Chagres River. Companies around the canal during the 1920s also employed large-scale corm transfer practices.

[250] Panama Times, Aug. 6, 1926.

[251] WH Babbitt, banana farmer from the US, to Meriwether L. Walker, Governor, Panama Canal, April 29, 1926, NACP RG 185, Entry 34, Folder 33-H-5.

Banana exports from Canal Zone ports

Year	Number of bunches
1922	208,688
1923	309,716
1924	840,321
1925	1,727,491
1926	2,182,688
1927	2,773,792

The Decline

The quantity of bananas shipped from Canal Zone ports peaked at 2.8 million bunches in 1927.[252] This was the high water mark. There is no easy answer as to why banana networks around Gatun Lake fell apart. There was no massive influx of wage labor opportunities, as there had been in the region with the initiation of the French canal project in 1881 and US canal project in 1904. Ecological, economic, and governmental factors all came into play in the decline. Ecological change led to decreased production. Five short years after the Zone was thrown open, Land Agent NA Becker reported "exhausted soil" across six hundred hectares, nearly ten percent of all leased land in production. This too might have been an unrecognized effect of *F. oxysporum*, as the basic symptoms of infection – leaf wilt and decreased fruit production – were similar to soil deficiencies.[253] He recommended that the 257 lessees in the denuded region – mostly

[252] Canal Record, Jan. 18 1928.

[253] Marquardt 2001, 49.

"aging West Indians" – be allowed to relocate elsewhere in the Zone. Gatun Lake banana production did not immediately decrease, but the exponential growth of previous years leveled out. Production was spatially redistributed as smallholders abandoned farms near the lake for more productive "virgin" lands higher in the Chagres River watershed.[254] Proximity to markets and transportation decreased as they moved up beyond the Canal Zone boundary. There were rumors, however, that a Trans-Isthmian highway (Chapter 3) might soon be built across the region.

United Fruit moved to consolidate its economic domination of the banana trade on the lake. Tensions between the company and small producers came to a head in June 1927 when weekly purchases were unexpectedly cut by half – from thirty-two thousand to fifteen thousand bunches – and the company announced that it would buy only from contract producers thereafter.[255] Devastated independent producers accused the company of leveraging its clout to force them into unfair contracts. United Fruit responded that it no longer had the capacity to buy low quality bananas grown around the lake as production increased at its company-run plantations. The market was drying up, even as smaller companies continued to buy. More problems emerged as the 1930s began. The onset of the global economic depression led to decreased demand for bananas in US markets. Prices fell to less than half of their levels in the mid-1920s.

[254] Canal Record, Jan. 18, 1928

[255] Panama American, June 30, 1927.

The Canal Zone Land Lease policy legally restricted the size of banana farms to fifty hectares, but the average land area leased was around four hectares per licensee.[256] In this sense, it was a holdover of a more smallholder-oriented business model that banana historian John Soluri calls "vernacular agriculture." Zone land agents reported in 1931 that farmers were unable to pay for their leases due to the difficulty of selling their fruit: "Most of our licensees are ex-canal employees, advanced in years, and very poor, and the collections are more difficult to make than formerly, the greater part of the rentals being collected by the land inspectors only after repeated calls on licensees in inaccessible locations."[257] Many renters were on the banks or islands of Gatun Lake, so the land inspectors used a canoe to collect rents, often with great difficulty.[258]

Governing populations at the rural margins of the Canal Zone was not merely inconvenient. Some administrators considered them to a menace to public health. The land lease program was permanently discontinued in 1932 when, after years of debate over the costs and benefits of allowing people to occupy rural Zone lands. Predominantly black, West Indian populations were thought to present a malarial threat to white suburban settlements and to be too expensive as lessees were able to draw on Zone hospitals and social services.[259] Sanitation was the larger issue. The Canal Zone Governor's decision to depopulate rural areas once again and to end the practice of issuing land leases was based on the recommendation of the Health Department. The

[256] NA Becker, Land Agent, Panama Canal, to CA McIlvaine, Executive Secretary, Panama Canal, Title, Dec. 30, 1922, NACP RG 185, Entry 34, Licensing Land in CZ for Agricultural Purposes, Folder 33-B-51(4).

[257] Memorandum for the Engineer of Maintenance, NA Becker, Land Agent, Panama Canal, Feb. 6, 1931, NACP RG 185, Entry 34, Licensing Land in CZ for Agricultural Purposes, Folder 33-B-51(7).

[258] Memorandum for the Auditor, NA Becker, June 14, 1932, NACP RG 185, Entry 34, Folder 33-B-51(8).

[259] March 26, 1932, NACP RG 185, Entry 34, Folder 33-B-51(8).

Governor of the Canal Zone described the decision in his 1932 annual report: "It is not practicable to care for any number of these people by allowing them to settle on land in the Canal Zone; many could not make a living in the jungle and the increases in malarial infection which have resulted in the canal towns from the presence of settlers on the land have led to the decision to license no more settlers. The most obvious form or relief is an increase in public works."[260]

CONCLUSION

In a letter to a colleague in 1930, Canal Zone horticulturalist Higgins explained that migratory banana agriculture around the canal was not simply a case of backward resistance to modern agricultural methods, but a rational reaction to the conditions created at the intersection of banana, transportation systems, and markets. His analysis is sophisticated and anthropological, linking infrastructure, ecology, export markets, and local land use practices. Smallholders around Gatun Lake were locked into a cycle of deforestation, cultivation, and migration to produce the standardized *Gros Michel* banana demanded by North American consumers – a variety highly susceptible to infection by Panama Disease. These farmers, Higgins explained, failed to invest intensive labor and capital in banana cultivation because they knew they would farm a plot for only a few years before it was decimated by the blight. Panama Disease diminished production, rendering producers' bananas less attractive to buyers. Growers constantly sought edge environments (along railroads, bodies of water, and highways), where the soil was "fresh" and transportation accessible. The symbiotic relationship between the banana and

[260] Canal Zone 1932, 33.

transportation infrastructure was its blessing and its curse. Its future as a variety was threatened by the same delivery and production system that supported its success.

The banana grounds the Panama Canal, literally, illuminating the contested history of land use in a transportation environment. Agriculture is not peripheral to, but intimately related with, the history of transportation on the isthmus. It has long been an economic buffer for transportation, providing a livelihood alternative for laborers when transportation employment was unavailable. During the first decades of the twentieth century, a small proportion of the area of the Zone was occupied by residential and transportation facilities. The remainder was rural, roadless, and poorly surveyed. It was here – at the margins of the Canal Zone – that the parameters of the US enterprise in Panama were negotiated. Were canal administrators exclusively operating a global transportation service or were they building a quasi-autonomous imperial enclave? The rise and fall of banana networks around Gatun Lake demonstrates that there was, for a time, no final answer to this question. Even as coalitions of administrators and labor leaders pushed for rural settlement and agricultural development, many others actively opposed the plan. The Canal Zone Land Lease program that began in 1922 and ended in 1933 evoked particularly charged inter-institutional tensions. Socio-ecologies thrived along the margins of the waterways that white administrators could not completely regulate or contain, a marked contrast to the organized grids of white Canal Zone communities clustered around the ocean cities of Panama City and Colon

Consider, again, OW Barrett's provocation in the epigraph, written nearly a century ago, "in three hundred twenty-five square miles of moderately suitable territory,

more or less isolated, how nearly self-supporting shall this area be made, what sort of horticultural development should it have and how much?" Looking back from the twenty-first century, canal administrators' answer seems clear: transportation and the service economy have displaced agriculture and rural production.[261] But it need not be final. By analyzing this shadow history of the Canal Zone, I hope to demonstrate that, though far from perfect, an alternative way of understanding and governing the relationship between agriculture, transportation, and sustainability did exist. It makes one wonder what a diversified, self-supporting regional economy might look like today.

[261] See chapter 4.

IV. CONCRETE (AND MUD): ROADS AND THE POLITICS OF MOBILITY IN A TRANSIT ZONE

"The [Canal] Zone is like Egypt; whoever moves must travel by the same route."
- Harry Franck [1913] 2006, 69

I never planned to write about a highway. I went to Panama in 2008 to study how watershed management has shaped the livelihoods of people in rural communities around the Panama Canal. But, sometimes, things make you pay attention. Driving regularly on the *Transístmica* changed how I understand the relationship between the canal and its rural hinterlands. The construction of this fifty-mile strip of pot-holed pavement was funded through US defense appropriations during the Second World War. When it opened to the public in 1943, it was – shockingly – the first interoceanic roadway in Panama since the demise of the Spanish colonial road (*Camino Real*) more than two hundred years before. The *Transístmica*, like the canal, runs between two port cities: Panama City on the Pacific Ocean and Colon on the Atlantic Ocean. But the two routes are quite different. In general, enormous ships pass smoothly through the canal, but, for people traveling on nearby roads, movement is an experience of friction: bouncing on bus seats, swaying in the crowded beds of pick-ups, and sitting in traffic jams.

The contrast between water and land travel points to a central paradox of life around the Panama Canal: this region has been organized around transportation for nearly

five centuries, but mobility has been – and remains – a challenge for many of the people that live here. Why is this the case? In this chapter, I argue that the same networked organization of transportation infrastructures that has facilitated global connection across this narrow strip of land has also contributed to local disconnection, producing spaces that are geographically close yet socio-economically distant. Transportation infrastructure is not designed to move everyone and everything everywhere. Instead, roads, rails, and canals channel people and materials along specific paths in support of particular social, economic, and political projects, often reflecting the priorities of politicians, engineers, and their publics. In this chapter, I argue that the establishment of socio-technical systems to move ships by water *across* Panama has also shaped and often disrupted land movement *within* the region. Put simply, getting across and moving around the isthmus are not the same, nor are they necessarily complementary. I examine the construction, use, and maintenance of the *Transístmica* and its feeder roads to illustrate how geographical and socio-economic mobility around the canal is shaped by the intersection of networked infrastructures[262] built to support projects that operate on different scales.

At first, my interest in the *Transístmica* was only practical. I traveled the highway between Panama City and the two rural communities where I conducted research. My drive to Boqueron, the more remote community, often began on the Gaillard Highway in the former US Canal Zone, now an upper-middle-class Panama City suburb. The highway runs along the east bank of the canal, skirting the old Zone communities of Balboa, Albrook, and Clayton. The road passes by the new Miraflores

[262] The concept of networked infrastructures is developed in Graham and Marvin 2001.

Locks Visitor Center, where busloads of foreign tourists pay eight dollars per head to see the canal in action. The Pedro Miguel locks, a few miles north, are frequented by Panamanian families, who watch the same ships pass through the locks for free through a chain-link fence.

Figure 4.1: Traffic on the Panama Canal and the Trans-Isthmian Highway.

Transportation histories are sedimented across this landscape. The legacies of nearly a century of US occupation (1904-1999) are readily visible across the northern outskirts of Panama City: manicured neighborhoods of bungalow houses, a hulking former military base that now houses the offices of the United Nations Development Program and Nature Conservancy, and, everywhere, the extensive physical infrastructure (power plants, machine shops, administrative offices, and dry docks) that makes transit through the canal possible. Beyond Pedro Miguel, one-story pink and gold houses line the roadside in Paraiso, a community largely populated by the descendants of West Indian canal laborers. Past Paraiso, a green lawn dotted with small white crosses slopes

up from the road, a reminder of an older, unsuccessful project. This cemetery memorializes a handful of the most valued lives lost among an estimated twenty thousand who died during the failed French canal project of the 1880s.[263] Veer eastward, away from the canal on Madden Highway, another old Canal Zone road. Forest canopy swallows the sky as you enter Soberania National Park, a green tunnel that feels ancient and insulated from the world around.

As you approach the former Canal Zone-Panama boundary five miles later, the forest thins and cracks radiate across the pavement. Turn left onto the *Transístmica*. The highway is a world of concrete: the hum of rubber on pavement, the odor of acrid exhaust fumes, the visual jumble of cinder block buildings and weedy secondary forest. This landscape is a jarring transition from that of the former Canal Zone, where the Panama Canal Authority has largely maintained the uniform architectural and landscape aesthetic – mowed grass everywhere – designed by North American planners. *Diablo rojos* (red devils), the former US school buses that have enjoyed lengthy second careers in Panama, are everywhere.[264] They roar and belch black smoke, lurching in and out of traffic to reach crowded bus stops. The roadsides are lined with the Asian-owned grocery stores that everyone here calls *chinos* and *fondas* (food stands) selling hot dogs and day-glow sodas. Despite the markedly different landscapes, there are hints that the *Transístmica* is bound up with the canal and associated transport service sector. Tractor-trailers haul shipping containers stamped with the logos of multinational corporations. Billboards

[263] Historian Michael Conniff points out that any estimates of mortality during the French canal project are guesses, but this figure has been widely cited (1985, 20). See also David McCullough's popular history of the canal (1977).

[264] According to the Panamanian Transit Authority (Autoridad de Tránsito y Transporte Terrestre), the Diablo Rojo buses in Panama City are slated to be replaced by government buses by the end of 2011.

promote American designer jeans, European watches, and Korean televisions for sale in Colon's *Zona Libre* (free trade zone) another thirty miles up the highway. The highway corridor is a world in motion, but it is also a bottleneck. As I said before, it is the only road across the narrowest stretch of the Americas.[265] In the event of construction or an accident, traffic comes to a halt. There are no alternate routes.

Now we're moving again. Turn left and you descend to the canal. Turn right and you drive toward rolling green mountains. Take the next right. Off the highway, drive through groups of boys in white polo shirts and green slacks chatting up girls in matching skirts. A red pick-up heavy with fruit creeps along the road, its driver droning into a megaphone mounted on the roof: "*plátano, guineo, mango, papaya* [plantains, bananas, mangos, papayas]." A *campesino* man in a straw hat, his pants tucked into knee-high rubber boots walks with a machete. Barbed wire fences demarcate teak forest plantations and cow pastures. A dog in the road struggles to its feet and moves, begrudgingly.

This rural landscape is less than thirty miles by road from Panama City and the Miraflores Locks, but it is a world apart. The people who travel this road regularly will tell you that it is *feo* (ugly). They are right. The surface is part asphalt, part gravel, and almost all in need of maintenance. People stand and sway in the crowded beds of pick-up trucks that carve wide S-pattern to avoid ruts and washboards. Drive through a few more small towns. Then, the power lines along the road disappear and the topography buckles. Downshift. The road – it's all gravel now – climbs and winds through the small

[265] During the period between when I left the field in May 2009 and my return in July 2010, the construction of a toll road called the *Corredor Norte* (Corridor North), running parallel to the *Transístmica* between Panama City and Colon was completed. However, this direct route bypasses the communities along the edges of the original *Transístmica*.

mountains. There are fewer houses and they are set back from the road. The Boqueron River appears on your right as you continue to climb. The river is clear now, but a few days ago it swelled and ran clay red after a heavy rain shower. Puddles of red water dot the road. The sound of your tires on the gravel announces your arrival in Boqueron.

Arriving in Boqueron

The families living along the road know you are here before you do. Faces peek down from the straggle of roadside *ranchos* – open-sided structures with palm thatch or tin roofs – and cinder block homes to see who you are. They shout greetings if they know you and stare if they don't. This is a small place that is getting smaller. The census of 2000 recorded 130 people living in the community, down from 183 in 1990.[266] People have moved to settings where life is a little easier. Many now work in the urban service sector or farm in places outside of the Panama Canal watershed, where agricultural land use is far less restricted. The town center is a cluster of white cinder block structures: an open-air community house for meetings, a three-room school, a tiny public health post, a Catholic church, and an evangelical church. The buildings are typical of many rural Panamanian communities, with an important exception. Perched high on the far riverbank is a hydrographic station that measures the flow of water from here to the canal.

People in Boqueron are always coming from or going to the *Transístmica*. They leave town, or "go outside" (*pa' fuera*), to work as day laborers, sell agricultural products, shop at discount megastores, seek government services, and visit friends and

[266] Government of Panama 2000.

relatives. Getting out and back is not easy. There are only two privately owned cars in town, so most people depend on bus transportation. The *diablo rojo* that comes twice a day – once early in the morning and once in the afternoon – binds life here with the rhythms of the highway. The town bus stop is the end of the line, so those that live higher in the mountains walk or ride horses, which they leave hitched to nearby trees. Due to local dependence on the bus, connections with the "outside" can be precarious. On my second day in Boqueron, a strike by the *Transportistas* – the national union of bus, taxi, and truck drivers – halted public transportation and left people in Boqueron and many other places stranded and facing hours of walking to complete their everyday activities.

The Politics of Mobility in a Transit Zone

Transportation was ranked, behind security, as the second most important issue in the 2008 presidential election.[267] Getting around the region around the Panama Canal takes an inordinate amount of people's time, money, and energy. Consider Alejandro Rodriquez, who commuted from Boqueron to work in the Colon free trade zone, where he earned $11.25 per day – too little to begin a life in the city without social connections. His commute from the *campo* to the city cost $3.60 – one-third of his pay – and took four hours. Life in the country is hard, Alejandro told me, but life in the city is harder. Here, at least, you can plant corn and *yucca* to eat. You only need to buy oil and salt for cooking. In the city, by contrast, if you don't have money, you don't eat. Alejandro quit his city job and returned to farming a small family plot in Boqueron. The logic of global commerce also makes small-scale farming difficult; producers lack the credit, marketing,

[267] La Prensa, Panama.

and transportation access to compete with domestic and foreign producers operating on larger economies of scale.

People have come to the isthmus from abroad with the capital, technology, and labor power to build roads, railroads, and waterways. It has been a repository of dreams of mobility, but benefits have not been widely distributed. The historical proximity of wealth and poverty, mobility and immobility is a phenomenon that still persists today, as evidenced by high rates of income inequality.[268] The sociologists John and Mavis Biesanz observed over a half-century ago, "The 'Crossroads of the World' at the convergence of international trade lanes, is a country with woefully inadequate internal transportation facilities. It boasts the first transcontinental railway and an ancient royal road, now overgrown with jungle, across the Isthmus. Not until the forties, however, when Uncle Sam finally built it, did it have a road from Colon to Panama…."[269]

ORGANIZATION OF THE CHAPTER

The chapter is organized in three sections. First, I explain how ethnographic research led me study and write about roads around the Panama Canal. I develop a conceptual framework by integrating a small anthropological literature on roads with theory on how materials – in this case, road surfaces – mediate human politics. Second, I draw on archival research to recover the geopolitics embedded in the construction of the interoceanic highway across Panama and discuss the problems engineers encountered as they laid concrete across an unstable landscape. I summarize this history, which has

[268] Panama ranked third in income inequality in Latin America in 2010 based on Gini coefficient calculations (United Nations Development Program 2010).

[269] Biesanz 1955, 132.

never been explored to my knowledge, because the political dramas and decisions around highway construction shape contemporary mobility.[270] Third, I draw on oral histories to show how the *Transístmica* opened possibilities beyond its builders' intentions. Rural people took advantage of its potentials and worked around its limitations.

THE ANTHROPOLOGY OF ROADS

When I began collecting oral histories in Panama, I did not ask about roads. But the people I interviewed, like Alejandro, kept bringing them up. After struggling to redirect people back to my planned interview topic – environmental management and rural livelihoods – I decided that I should add some new questions to my interview guide to learn about the histories of the narrow feeder roads that run from the *Transístmica* to the communities of Limon and Boqueron. I asked:

- Was there a road here when you arrived?
- When did the construction of the road begin? When was it finished?
- Who built the road?

The questions seemed straightforward enough. But, in interviews, the road emerged as a tangle of people, events, and materials shot through with interpretations of the relationship between the past and present. I could never get the story of the road straight. Following historian Alessandro Portelli, we might approach this as an interpretive problem inherent in conducting oral history:

> The first thing that makes oral history different, therefore, is that it tells us less about *events* than their *meaning*…the unique and precious element which oral

[270] This approach to recovering the past politics embedded in technical systems is what Geoffrey Bowker has called an "infrastructural inversion" (Bowker 1994, Bowker and Star 1999). See also Langdon Winner's (1986) theory of technological politics. He writes, "The issues that divide or unite people in society are settled not only in the institutions and practices of politics proper, but also, and less obviously, in tangible arrangements of steel and concrete, wires and semiconductors, nuts and bolts." (1986, 29).

> sources force upon the historian and which no other sources possess in equal measure is the speaker's subjectivity…we might say that oral sources, especially from nonhegemonic groups, are a very useful integration of other sources as far as the *fibula* – the logical, causal sequence of the story – goes; but they become unique and necessary because of their *plot* – the way in which the story materials are arranged by narrators in order to tell a story.[271]

What analysis of my interview transcripts later made clear was that my questions, designed to reconstruct chronological history, were embedded with assumptions about roads that reflected my experiences growing up in the southeastern US. For generations, aspiring ethnographers have been inculcated with a reflexive attitude toward our own cultural assumptions.[272] We are less equipped, however, to question the infrastructural assumptions we carry into the field. But they also shape what we think we already know and, therefore, what we need to ask. My assumptions about roads were as follows: (1) They are constructed by a single builder, generally a state institution. (2) They are built through a linear beginning-to-end process. The transition from disconnection to connection thus represents a clean historical break. (3) They function and you can forget about them. In oral historical accounts in Boqueron, however, people described the road as unfinished. It did not arrive, but advance and retreat over time in relation to the actions of the changing networks of capitalists, entrepreneurs, and government officials that channeled money and labor into the region. Consequently, the road is not taken for granted. It persists as a matter of concern in Boqueron and neighboring communities precisely because local connectivity and possibilities have fluctuated in relation to its construction and maintenance.

[271] Portelli 1991, 50

[272] Clifford and Marcus's Writing Culture edited volume (1986) is the seminal call for reflexivity around the textual production of ethnographic authority. They saw culture as composed of contested codes and representations, meaning that ethnographic writing is an act of cultural invention not representation.

Figure 4.2: Rural roads near the Panama Canal vary in terms of maintenance.

Anthropological scholarship on roads has often framed their construction to and arrival in rural communities as a pivotal historical moment met with local ambivalence. In most cases, rural people seem to want the benefits of paved roads, but believe that the state and urban forces that accompany them may change things for the worse.[273] Some anthropologists have examined how people deploy roads in discourse to represent past and present relationships with other groups, particularly the various social dislocations associated with colonialism and unfulfilled promises of modernity.[274] Applied anthropologists and development studies scholars have been most interested in evaluating the correlation of road construction projects with indicators of poverty alleviation, including access to markets, employment, and health programs.[275] Each of these approaches has provided important insights, but the materiality of roads is often

[273] de Pina Cabral 1987, Fairhead 1992, Hunt 1999, Orlove 2002, Roseman 1999.

[274] Giles-Vernick 1996, Masquelier 2002, Redfield 2002.

[275] Dawson and Barwell 1993, Gibson and Rozelle 2003, Windle 2002.

neglected in anthropological work focused on language and perception. What about the roads themselves?

Gina Porter suggests that rural people often describe poverty in terms of access to physical infrastructure, particularly roads.[276] For many people, in other words, roads serve an interpretive function. Although this corresponds with my findings in Boqueron, the claim is also too general. People talk about bad roads and non-existent power lines to frame more than a general state of poverty. Infrastructure provides a means of talking about changing connections with – and access to – other people and places, as well as a tangible object for conceptualizing the relationships between development and underdevelopment. A road is a symbol, but it is more than that. My interviewees' "story materials," to use Portelli's term, were gritty: dirt, gravel, and concrete. The changing distribution of these materials across the landscape does not simply reflect power relationships – which assumes that social asymmetries stand prior to and independent of the road. Human inequities are shaped or mediated by non-human forces.[277]

Here, I am inspired by the work of scholars who bring the mundane transportation surfaces into analyses of social and political life. On Barak has described how specific road surfaces shaped social space in unexpected ways in turn-of-the-twentieth century Alexandria.[278] He argues that new granite-paved roads shaped emergent forms of social life in the city, including increased urban violence and instability. It was not granite, but concrete: the inexpensive composite of cement, water, sand, and crushed stone that

[276] Porter 2002.

[277] Bennett 2010, Latour 2005.

[278] Barak 2009.

became the quintessential road surface of the twentieth century. In a recent article on the relationship between concrete roads and public space in Peru, anthropologist Penelope Harvey explains its seemingly ubiquitous appeal as a construction material: "Concrete is useful because it combines [an] initial flexibility with a powerful fixing capacity, which has led to its ubiquitous and dominant deployment in unruly settings and all kinds of environmental conditions. Its associations with standardized forms that transcend the specificities of local conditions have given the material great value for the regulatory spaces of the modern state." The mixture's standardizing potential makes it an ideal medium for would-be social engineers to pursue projects that integrate both technological and social design elements.[279]

Road materials turn our attention not only to the intentions of designers, but also to the transformations a route undergoes through use in the months and years after a surface is laid. Paved roads are often constructed by state institutions as a top-down project. But, they are then transformed through the use and work of multiple communities. They can become different things. "A tool" write Susan Leigh Star and Karen Ruhleder, "is not just a thing with pre-given attributes frozen in time – but a thing becomes a tool in practice, for someone, when connected to some particular activity…By analogy, infrastructure is something that emerges for people in practice, connected to activities and structures."[280] Clean, hard surfaces are repeatedly abused by tires, hooves, feet, and water. A road, like any infrastructure, both serves and depends on people. Put

[279] This is what actor network theorists call heterogeneous engineering (Law 1987, Law and Callon 1995).

[280] Star and Ruhleder 1996, 112-113.

another way, it needs a community to maintain it, even as it shapes a community.[281] Without maintenance, however, the road becomes difficult to traverse. Potholes, cracks, and puddles create trouble for travelers as a smooth concrete or gravel surface blends with the environment. Geographer Chris Otter points out that road materials are part of the surrounding landscape.

> Like rivers and mountain passes as well as canals, tramlines and railways, streets are not everlasting routes etched into the face of the earth. In order to become relatively durable they require the cooperation of humans (workmen, pedestrians, cleaning systems), matter (which must be resilient and cohesive), and atmosphere (by avoiding corrosive chemicals dampness and climatic extremes). If these elements are harmonized, the street's fundamental impermanence can be masked.[282]

The potholes, washboards, and cracks that spread across pavement when it is not well maintained reflect this community and also shape human mobility. In Panama and elsewhere, road surfaces facilitate lines of motion and complicate others, formatting both space and everyday life.

CONSTRUCTION OF THE *TRANSÍSTMICA* (TRANS-ISTHMIAN HIGHWAY)

The automobile was less than two decades old when the Panama Canal opened in 1914. Around the world, paved roads were restricted to cities. Beyond urban boundaries, mobility was tied to railroad lines and dirt roads. At that time, more than ninety percent of the roads in the United States were "muddy, rutted, dirt paths, threatening to mire motor vehicles up to their hubs.[283] For those without paved roads, they were something to aspire to. During the early-twentieth century, Panamanians clamored for a paved road

[281] See, e.g., de Laet and Mol 2002 on the fluid boundaries of the Zimbabwe bush pump.

[282] Otter 2004, 243.

[283] Goddard 1994, 3.

of their own: a trans-isthmian highway that would run parallel to the US-controlled canal and railroad line. The editors of national newspapers, who agreed on very little, argued that such a highway would facilitate free – that is, independent of the Yankee control – and rapid passage between Panama City and Colon, while opening up the arable land in between for agriculture. This refrain resonated with an international discourse about paved roads' potential to "release the energies" of a land.[284] But not just any material would do. Modernity would travel over concrete.[285] A 1923 editorial in the *Star and Herald* made the case for the concrete roads in Panama: "There seems to exist in the minds of a great many a mistaken idea that concrete construction is a luxury to be used only for city streets. This 'hooey' has always been fostered by the advocates of an old semi-permanent type of pavement. Gravel and water-bound macadam might be cheaper in the short term, but required much higher maintenance rates. It is practically impossible to maintain macadam in the tropics."[286]

Panama had neither paved roads nor the capacity to produce the cement used to make concrete.[287] The existing roads were called *caminos de verano*: dirt paths passable

[284] On opening natural energies through transportation technology, see Richard White's discussion (1995, 35). He writes, "In Emersonian terms, putting land or water to work was opening, at least potentially, a new access to nature. Emerson had rejoiced in the 'magic' of railroad iron, 'its power to evoke the sleeping energies of land and water."

[285] On concrete and speed, see Taussig 2004, 159-172.

[286] *Estrella de Panama*, July 12, 1923.

[287] Panama's first cement factory, *Cemento de Panama*, opened along the *Transístmica* in 1947 (Heckadon-Moreno 1986, 194). Prior to that, the lack of cement for public works was cited as a major impediment to national development. For example, in 1943, the editor of the state-published *Revista Agricultura y Comercia* magazine [Review of Agriculture and Commerce] wrote, "Panama is a country that is developing every day. Every year, a greater quantity of cement is – and will be – necessary in our republic [for both private and public works projects]…public works rise from a cement base…we need a cement factory. Our neighbors, like Venezuela, Colombia, Ecuador, and Peru have cement factories with which national needs are served and none have failed…"

by foot and pack animal and, during the dry season, by wagon.[288] Travel within regions was organized around North-South river systems that linked the coasts and mountains.[289] Travel between regions was organized around East-West steamer routes that connected ports on both coasts.[290] Panamanians in the transit zone could also travel via the US-controlled Panama Railroad. The government of Panama established a roads department (*Junta Central de Caminos*) in 1920 to facilitate the construction of a national road network; its initial mandate was to develop "penetration roads," small dirt roads that would stimulate agriculture by connecting the rural interior and ports.[291]

Panama Divided, the World United

The union of the Atlantic and Pacific Oceans via the Panama Canal physically cut Panama in half. There was no bridge linking the two sides, so transportation between them depended on barges, tugs, and ferries. Moreover, the flooding of Gatun Lake erased many former local transportation routes around the Chagres River. A geographer describing environmental changes associated with the Panama Canal described the old routes' disappearance: "most of the foot-trails were obliterated and the narrow, well-defined canoe routes became lost in a maze of flooded forests, the tortuous channels no longer indicated by wooded banks or rapid currents…broad, stagnant, forested waters were covered here and there by flooding vegetation and driftwood that often blocked the old route, making travel uncertain."[292]

[288] Heckadon-Moreno 2005, 282-284.

[289] Castro Herrera 2007.

[290] Porras 1953.

[291] Heckadon-Moreno 2005: 282-284, Roberts [1932]2006, 224.

[292] Shiras 1915, 163.

Geopolitics and a new physical geography articulated to restrict mobility in the transit zone. Panama did not have the legal authority to build a land route across its sovereign territory without a waiver from the United States. The Panama Railroad had exclusive rights to interoceanic transportation on the isthmus due to an 1867 agreement between the company and government of Colombia, which governed Panama at the time. Colombia granted the railroad a 99-year monopoly on "any class of carriage roads whatever, from one ocean to another."[293] When the US government purchased the railroad in 1903, it inherited these monopoly rights. Some US administrators in Washington DC and the Canal Zone preferred that Panama not be given the waiver to build a trans-isthmian highway. They did not see the road as a potential commercial rival to the canal, but were concerned about epidemiological and military issues. For the civilian Canal Zone government, tropical disease was a key concern. Despite their famous achievements sanitizing the Zone,[294] administrators worried that increasing flows of automobiles along Panama's developing road network beyond the Zone would also speed the movement of malarial mosquitoes.[295] Lines of human communication were understood to facilitate disease communication between "native" and US communities.

Military commanders also maintained that mobility on the isthmus made the canal more open to attack. In fact, the first governor of the Canal Zone**,** George Goethals, was convinced that an unbroken forest without roads afforded the canal a natural defense

[293] Contract of 1867 between the United States of Colombia and the Panama Railroad Company, Article V.

[294] Gorgas 1915, Sutter 2007.

[295] Memorandum for the Governor, Panama Canal, by NA Becker, Land Agent, Panama Canal, Dec. 2, 1931, NACP 185, Entry 34, Licensing Land in CZ for Agricultural Purposes, Folder 33-B-51(8).

from potential invading forces. "With the jungle," he argued, "large bodies could not be moved with ease and rapidity, and though small parties might work their way to the locks, they could do no damage if the defense was alive to its duties."[296] As discussed in the first chapter of the dissertation, defense and sanitation were among the stated motivations for depopulating the rural areas of the Canal Zone during the 1910s and allowing secondary forests to grow up. Ironically, the characteristic traits of tropical nature that the Isthmian Canal Commission had struggled against during the early years – heat, insects, and disease – were to be enlisted in the defense of the waterway.

However, as military technologies changed, so did the tenor of discussions about road construction around the canal. If forest cover discouraged ground forces, it did not deter airplanes.[297] Within this new context, the US government agreed in treaty negotiations with Panama to appropriate $45,000 to conduct a survey for a potential trans-isthmian highway.[298] The absence of a central road between the oceans with a network of auxiliary roads made it impossible to move motorized forces quickly between the oceans and to the antiaircraft batteries and searchlights that comprised the outer periphery of canal defenses.[299] The military went forward with a plan in the mid-1930s to construct 130 miles of hard-surfaced defense roads in Panama that would link the expanding canal defense network. The critical question for was no longer *whether* to

[296] Goethals 1915, 66-67.

[297] The revisionist thinking about the jungle defense was summarized in a 1935 canal defense report, which concluded: "The jungle is not by any means always an asset to the defense; on the contrary, by limiting fields of fire for all weapons, it frequently favors the attackers, who will presumably be in superior numbers. The fact is that the unbroken jungle can almost anywhere by traversed by considerable forces in any direction, with proper organization of working parties at a rate of 4 or 5 miles a day."

[298] Canal Record, Aug. 15, 1933.

[299] Annexes to The Project for the Defense of the Panama Canal, Records of US Army Forces in the Caribbean, Panama Canal Department, NACP 584, Box 15, Defense Plans and Projects, 1925-1934.

build roads, but what *kind* of roads to build. Army engineers had learned that road construction was quite different in Panama than in the US. Plants grew across roadways and actively destroyed gravel and macadam surfaces. Therefore, army engineers began to focus on stabilizing an unruly tropical landscape through the construction of well-drained and maintained concrete roads, as described in 1928 by Major General Malin Craig:

> Trucks have been observed to break through a waterbound macadam road, apparently in good condition, only a year old. In addition to the action of vegetation the terrific downpours cause rapid deterioration of these roads. Ditches, which are ample for ordinary rains in the States, overflow across the roads and soon wash out the top dressing, leaving the road-bed exposed. Road maintenance work…involves keeping ditches open and thoroughly dug out, throwing back stone which is thrown aside by truck traffic, removing 'cave-ins' which frequently fall on the road, keeping culverts open, destroying vegetation, and keeping the grass clear so that the road will dry out… Conversion into concrete is recommended as that material is not penetrated by vegetation, is essentially self-maintained, and has, with the small traffic to be expected, practically infinite life.[300]

Macadam paving was cheaper – three-fourths of the cost of concrete – but maintenance costs were double. Concrete was considered necessary for heavily used roads and macadam fine for auxiliary roads.

The New Geopolitics of Roads in Panama

The US and Panama signed an agreement to build a trans-isthmian highway in Washington DC on March 2, 1936. In Article I of the convention, the US government agreed to waive the railroad's monopoly rights in order to allow the government of Panama to construct the highway. This marked the end of the foreign monopoly on interoceanic ground transportation in Panama. For more than eighty years, the railroad

[300] Malin Craig, US Army Major General to Dr. John Glover South, US Minister to Panama, Oct. 27, 1928, NACP 548, Panama Canal Department NACP 548, Box 74, Decimal File 1915-1945.

had been the only line of land communication between the nation's largest cities. More incredibly, perhaps, there had not been a road across the isthmus since the deterioration of the Spanish *Camino Real* two centuries before. Panama planned to build a road from Madden Dam – the end of the road system on the Pacific side – to Cativa, near the Canal Zone border on the Atlantic side. The US agreed to construct "without delay and at its own expense" a road between Cativa and the existing road system on the Atlantic side.

The 1936 Trans-Isthmian Highway Convention was ratified on July 25, 1939. As the Second World War loomed, the US military scrutinized Panama's road system and found it underbuilt and poorly maintained.[301] Within this new geopolitical context, the construction of previously proposed paved roads and the long-discussed highway suddenly became a defense priority. A State Department official wrote: "The reasons for which this Government considers the construction of the Trans-Isthmian Highway to be a project vitally concerned with our national defense are, to my mind, obvious. At the present time the surface means of transit across the Isthmus of Panama are limited to the Canal and a railroad. In these days of motorized and mobile equipment for the armed defense forces of the country, it is of the utmost importance that a hard-surfaced highway be built across the Isthmus."[302] Meanwhile, at home and at US overseas outposts, the Public Roads Administration was building a national network of defense roads. In mid-1940, Franklin Roosevelt requested $325,000 in emergency defense funds from Congress

301 G-2 Appendix to the Basic War Plan Panama Canal Department, p. 15-16, NACP 548, Box 16, Defense Plans and Projects, 1935-1938. Under war conditions, previously approved Panama Canal defense projects were to be constructed by the Army Corps of Engineers, civilian engineers, and the Panama Canal government. See Engineer Annex to the Basic War Plan Panama Canal Department, p. 6. , NACP 548, Box 16,

302 Statement of Finley, Asst Chief, Division of American Republics, Dept of State, May 31, 1940, NACP 59.Decimal,

to build the United States portion of the road over the mangrove swamps between Colon and Cativa.[303] Panama was given a $3.2 million loan by the Washington-based United States Export-Import Bank to build the longer stretch between Cativa and Madden Dam. Under the terms of the loan agreement, the road would be built by the Public Roads Administration, part of the United States government, which would be responsible for all expenditures, as well as the specifications, design, and construction.

The construction of the US section of the highway was underway when the Public Roads Administration analyzed the proposed technical specifications of the Panamanian section and found them inadequate for projected civilian and military traffic. The Panamanian government planned to build a two-lane, eighteen-foot-wide road. But the Roads Administration argued that a much larger road would be necessary for war: four lanes and forty feet in width. "The pavement" a Federal Works Administrator wrote to President Roosevelt, "should be sufficiently heavy to carry mechanized military equipment, and should have shoulders sufficiently wide to permit stopping for repairs or parking without blocking traffic on the paved sections."[304] Ultimately, the Public Roads Administration recommended that the US government take over the construction of the Panamanian section of the highway and pay the additional cost of a "heavier and better design." As technical specificities were debated in Washington, the Export-Import bank put Panama's highway loan on hold pending a decision.[305]

[303] NA2 59.Decimal, March 5, 1940.

[304] NA2 59.Decimal John Carmody, Administrator of Federal Works Agency to President Roosevelt, July 29, 1940.

[305] NA2 59.Decimal, June 17, 1940.

The Trans-Isthmian Highway was designated a defense road in 1940. Roosevelt authorized the allocation of $3,675,000 to the Public Roads Administration from the "Emergency Fund for the President" to construct the Panamanian section of the highway. The designation meant that the road met War Department and Roads Administration defense standards.[306] Panama would provide a right-of-way, but no financial contribution. This was a major project that required heavy equipment and significant labor. The organization of men and machines echoed canal construction work three decades before. Fifty tractors and men to operate them were imported from the US. The Public Roads Administration announced that all unskilled labor – "instrument men, chainmen, rodmen, and machete men" – would be Panamanian. "Operators for heavy power equipment have been imported from the States on account of their experience with the type of equipment used."[307] Rain, vegetation, and mud made paved roads necessary and, at the same time, a challenge to build. The ecology of the wet tropical forest drove up construction costs and troubled equipment built for drier climates.[308]

Construction of the Panamanian section of the highway – to cross twenty-five miles of forests, rivers, and rough topography – began in December 1940 when machete men began to "hew away at the jungle" at three points along the route.[309] During the dry period between January and March 1941, half of the forest along the route was cleared.[310] Excavation began, with the earth being cut as deep as one hundred feet. Culverts were

[306] NA2 59.Decimal, Hull to Smith, January 8, 1942.

[307] Draft Press Release, 3/7/1941, NA2 59.Decimal.

[308] NA2 548.16, "Engineer Annex to the Basic War Plan Panama Canal Department," p.2

[309] Panama American April 17, 1942, 1, 6).

[310] Letter Federal works to State dept, 4/28/1941, NA2 59.Decimal.

laid below the roadbed to divert water underneath and immense soil fills used to plug the deep ravines along the route. Rainfall increased as the dry season ended and built further into June and July, when the rivers swelled and roadwork stopped intermittently.[311] By August, machinery stood idle and the crews waited for the weather to break.[312] Construction work began again in January 1942 as the work of laying two ten-foot strips of concrete commenced on the Atlantic side. [313] Laborers slit dumped sacks of cement into trucks, which fed the paver as it slowly laid down concrete over the clay roadbed.[314]

Estará Abierta al Tránsito Civil la Carretera Entre Panamá y Colón

A fines de Mayo estará terminada esta nueva ruta

Una de las dos pistas está completamente pavimentada y

La carretera transistmica, cuya apertura se anuncia para dentro de poco, podrá ser usada tanto para el tránsito civil como para el militar una vez terminada, según se supo hoy en el Cuartel General del Departamento de la Zona del Canal, en Quarry Heights. Esta declaracion fué hecha al "Panamá-América" como contestación a los rumores que han venido circulando insistentemente de que el tránsito en la nueva vía sería permitido únicamente

(Pasa a la Página 6 Col. 3)

El Dr. Ernesto Zubieta irá al Congreso de Urología en México

La Carretera Transístmica

Figure 4.3: Paving of the *Transístmica* nears completion, May 7, 1942. [315]

[311] Panama American, April 17, 1942: 1, 6.

[312] NA2 59.Decimal Memo Chorrera-Rio Hato Highway, Public Roads and Dept of State, August, 21, 1941.

[313] Panama American, January 10, 1942: 1,9.

[314] Panama American May 7, 1942, 1, 6.

[315] Panama American.

A convoy of US army trucks completed the first automobile trip by road between the oceans in Panama on January 21, 1942, after the Atlantic- and Pacific-side construction forces met at the Gatun River.[316] It was dirt, but an interoceanic road, nonetheless. Paving continued for the next three months with pauses for unusually powerful torrential rains until a concrete lane was complete. "It is possible," the *Panama American* announced on April 17, 1942, "for a car to drive on modern concrete highways from the Pacific to the Atlantic in a little over two hours."[317] The road was dedicated as the Boyd-Roosevelt Highway and opened to the public on April 15, 1943. In his dedication remarks, Panamanian President de a Guardia used the new concrete road to link Panama with a colonial commercial history. He said, "The new road, built along the most modern lines of reinforced concrete becomes the present-day successor to the Panama-Portobelo mule train of the colonial days…"[318] The president's phrasing – "modern lines of reinforced concrete" – framed the completion of the new paved highway across the isthmus as a transformational moment for Panama, a moment when a sovereign nation embraced its transportation legacy on its own terms, outside of the shackles of colonialism and imperialism. The next section of the chapter examines what happened along the highway after its completion.

LIFE ALONG THE *TRANSÍSTMICA*

Describing the changes around the arrival of the railroad in colonial Indonesia, Rudolf Mrazek observes the powerful attraction of modern transportation infrastructure: "As soon as rails were laid and the first train appeared, people, the whole landscape,

[316] Panama American April 17, 1942: 1, 6.

[317] Panama American 4.17.1942: 1, 6.

[318] The Star and Herald, April 16, 1943.

turned around and moved to the train."[319] In Panama, the landscape turned around to face the *Transístmica* before the road was even finished. In May 1942, nearly a year before the highway was officially dedicated and opened to the public, President de la Guardia and other state officials inspected the road with the Public Roads Administration's chief engineer in Panama, John Humbard. State institutions saw the land along the *Transístmica* as a potentially productive agricultural region with access to established ports. Even then, the roads department was building *caminos de verano* (dirt roads) that would connect rural communities previously linked by a network of unpredictable rivers and muddy trails shaped by the weather to a single, year-round concrete route. In the communities around Gatun Lake, many of the boatmen (*lancheros*) who had ferried townspeople across the lake to work in the Canal Zone or sell agricultural products in Colon, sold their boats and bought small buses (*chivas*) to transport people to and from the new highway. Contemporary residents told me that the towns began to "decay" as their inhabitants migrated up to settle along the new highway.

From a temporal and spatial distance, the story takes on an air of inevitability. The geographer Charles Bennett concluded, decades later, that the construction of the *Transístmica* "stimulated" the settlement of an isolated area and that swidden farmers "invaded" the region.[320] This narrative – still prominent today – portrays rural history as an inevitable and mechanical process. A road built across arable land in the context of landlessness and poverty is understood to "release" social energy or lead to "spontaneous" settlement. In this theoretical construction, political-economic relations

[319] Mrazek 2002, 10.

[320] Bennett 1968, 89.

are thought to exist on a plane that is both prior to and independent of concrete and mud. On the ground, however, for those whom the road supposedly stimulated, the historical relationship between *Transístmica* and its hinterlands is understood differently. Rural settlement has always been a precarious achievement. Like any project, it requires a functional support system, an infrastructure. And that infrastructure has to be maintained. Through hard work and contingency, a network of small places emerged that were intermittently connected to the highway by dirt roads and capricious waterways. In the paragraphs that follow, I draw on oral histories to write a genealogy one of these roads. What emerges is a non-linear history of starts, stops, accidents, deviations, and reversals.[321] As I argued in the first section of the chapter, road histories are always about design, materials, and maintenance.

The long-awaited highway – just two concrete lanes – sounds modest in retrospect. But Andres Diaz, among the first wave of migrants to settle along the new highway in the early-1940s told me how rapidly the *Transístmica* transformed a region, even giving new names to old places.

> Ashley: Why did people move to Buena Vista?
>
> Andres: Well, it wasn't called Buena Vista yet. Buena Vista was born around 1947, '48, '49. Before then it was called Agua Sucia [dirty water] because there is a river there called Agua Sucia. There were a few little houses – it wasn't much…
>
> Ashley: Let me be sure I have this right. The people that came here in the early 1940s moved from the banks of Gatun Lake and the city of Colon…

[321] This is inspired by the genealogical philosophy of history developed in Foucault 1984. Foucault's approach to history is anti-essentialist. Behind things is "the secret that they have no essence or that their essence was fabricated in a piecemeal fashion from alien forms" (78). Thus, rather than tracing an unbroken line from past to present, a genealogy begins with the things produced through a history of non-linear and entangled events. He understands events like reversals, deviations, and mistakes not extraneous to historical processes. They persist in the present.

> Andres: *Eso*, that's the history. So, look, there was a fire in Colon – that was what motivated us to leave …and they [the US Canal Zone government] didn't want people farming in the Zone. So what did people do? Some went to the city. Some to work in the Zone. Others of us came here, to the *campo*, to work in agriculture. This group of people…came up with the idea of planting bananas along the edges of the *Transístmica*. It was just a gravel road then, like we have in Boqueron today…Raul Segura and his brother had trucks. They bought the bananas and transported them to Colon for export.

Andres wanted me to understand that Raul and the others were creative, but that their innovation was to adapt an existing strategy to new economic, ecological, and infrastructural conditions. West Indian, Colombian, and Panamanian men and women were laborers during the construction of transportation infrastructure. When construction was complete, they devised livelihood strategies that took advantage of the margins of the newly built lines. In this way, the opening of the *Transístmica* shaped an infrastructural ecology not unlike that created when the Panama Canal opened in 1914 and laborers were laid off *en masse*.[322] People adapted the agricultural practices used along the banks of lakes and rivers to the edges of a highway. Andres said: "1914, imagine it! All of these people came to work on the canal, not to farm. When they finished the canal, the people stayed. Options? Bananas! They began to plant bananas. But because of [Canal Zone] restrictions [against farming] people were forced to leave. So they moved to Agua Sucia: 'Yes sir, there's good land there. You can plant bananas and there is a road project coming.'…That is what they did. Sell bananas, drink *aguardiente*, and live quietly."

Life was quiet and traffic was sparse when people first settled along the *Transístmica*. "When I was a kid," a man who grew up along the highway in the 1950s

[322] This history is detailed in chapter two of the dissertation.

said, "we played baseball in the road. After an hour, one car passed – an hour later, another car. Most of them were Americans – lots of soldiers – but only a few individuals. We played in the road, lied down on it, and, at night, sat and listened to stories." The same road was a different space for white North Americans, who traveled between its urban termini rather than over its rural margins. Zonians driving between Panama City and Colon were discouraged from stopping in "unsanitated areas" in Panama after dusk. "Evening drives," a 1942 Canal Zone circular admonished travelers, "are safe only if the automobile is kept at a normal rate of speed and no stop is made."

As soon as the *Transístmica* was opened, it was becoming something different than what engineers and state officials had envisioned. From moving vehicles, Zonians must have seen the edges of a region increasingly accessible to and reworked through agricultural activity. Susan Leigh Star has shown how "communities of practice" emerge at the intersection of specific technologies and problems. These heterogeneous collectives work around the edges of formal infrastructures. Over time, she argues, the formal and the informal merge, producing something new and hybrid.[323] A community of loggers, local transportation providers (*transportistas*), and colonists extended roads out from the highway into the rural areas and created new worlds.

Loggers, Colonists, and the Life of a Dry-Season Road (*Camino de Verano*)

Few in Boqueron today remember Macario and the early loggers well. But nearly everyone agrees that they cut the first *camino de verano* – a dirt road that is often passable and in use only during the dry season – along the north bank of the river. We

[323] Star and Ruhleder 1996, 132.

know that the loose dirt road was built by 1957 because Smithsonian scientist Dr. Alexander Wetmore photographed it during that dry season, the second of a series of collecting trips he made around Madden Lake.

Macario's tractor opened a path to the good lumber around the river. People remember that the road pictured above to the left was not sufficient for the kind of trucks pictured on the right to pass. So, during the dry seasons, the loggers paid laborers to fell large trees with hatchets and handsaws, plowed paths down to the Boqueron River, and floated the logs down the river to a waiting barge on Madden Lake, where they were transported by water and then by truck to urban markets. During the rainy seasons, when loggers could not enter, they paid men a few dollars to stay and cut trees with hatchets for extraction when the road dried out again. They logged *Espave, Maria, Roble, Amargo Amargo, Cedro Amargo, Cabemo, Amarillo, Tachuelo* without state restrictions. Of these, *Cedro Amargo, Roble,* and *Amarillo* were the most valuable.

The forests close to the canal had been logged for at least a century, dating to the construction of the Panama Railroad in the 1850s.[324] But the construction of the *Transístmica* made it easier to move heavy machinery into and logs out from the region around the upper Chagres, Boqueron, and Pequeni rivers, where large timber had been difficult to access. The logging road also opened the area's rugged, forested mountains and the growing population along the *Transístmica*. The first two families – the Seguras and the Garcias – settled in Boqueron in the dry season of 1958, a year after Wetmore's

[324] See Castro Herrera 2005. Until the late-twentieth century, logging was unregulated. Companies contracted workers to cut the most valuable trees around the canal. They floated the logs out by water for sale in the Canal Zone and elsewhere (Heckadon-Moreno 1981, 6). By 1915, natural scientists in the Zone reported that nearly all of the forest within sight of the passing steamers and trains was secondary growth (Barrrett, March 23, 1915, NA2, 185.34.33.h.3, pp. 7-8).

photograph was taken. Raul Segura, his wife Florentina, and their daughter Elvira arrived first. Raul, who Andres described as a key player in the *Transístmica*'s short-lived banana economy during the 1940s, relocated his family from Buena Vista to Boqueron, where there was land to farm (*tierra libre*), and settled across the river from an unmanned Panama Canal hydrographic station. The second colonists, Eusebio "Chevo" Garcia and his son Tomas, arrived on foot only a few months after the Seguras. Originally from Chorrera, west of Panama City on the Pacific coast, Chevo and Tomas had spent most of the past decade moving around the country searching, like Raul, for *tierra libre*. They wanted to work land to which nobody else had a title or possessory right. They found the land they sought in Boqueron. There was no such land left along the *Transístmica*, but Boqueron was still frontier.

The children of these families, now grandparents, told me that the first wave of settlement worked like this: a rubber tapper, a hunter, or a logger would travel through the forest. As he traveled over the highway and into the cities, he would share information about the land he had seen with people – including farmers looking for land. I asked Luis Segura, Raul's son, how he learned about the area. "You know how people talk," he said, "'Listen, up there, they made a road and they're starting to work the land.' And one person told another like that." Word spread that the land was *montaña virgin* (virgin forest) and it was available. *Montaña* is an important word in rural Panama. It refers to land that has been neither settled nor cultivated. The narratives of the first settlers to arrive Boqueron are what one would expect of people settling an area understood to be wilderness. Settlers remember fertile soil, forests full of wild game (deer, iguanas, birds, wild pigs, large rodents called *pacas*), and a river full of fish. The

legacies of previous extraction were few: a few hunting trails, crumbling buildings around a manganese mine abandoned after the First World War, overgrown banana plantations. The land was not "tired," as it was where most of the migrants came from, but "rested" (*descansado*). People began to clear the forest and plant crops.

Boqueron was bountiful, but it was also a difficult place to live in the late-1950s and early-1960s. The river flooded and swept away houses built in its flood plain. Massive trees fell in the wrong direction while being cut and killed men clearing them to make fields. Plagues destroyed entire crops. But, in those early years, the biggest problem was transportation. When the community was settled, there were two routes – on foot over the *corte* or by boat over the river and lake – to get to the *Transístmica*. The highway was less than twenty miles away, but both routes made moving people and cargo difficult. The river and Madden Lake rose and fell in relation to climatic conditions. "The river," one man said, "was larger then. They would make a canoe to carry their cargo out…In the rainy season, when the river was high, they had to travel on the banks. Leave the canoe there and leave on foot by land. Or wait until the river would go down a little." The *corte* was pure mud for most of the rainy season. It could take five hours to walk to concrete without cargo, twice that with a pack animal or in muddy conditions. Getting to and from community was so difficult that many people abandoned their farms.

The *camino de verano* was a work-in-progress shaped by local traffic, regional climate, and changing extra-local demand for commodities like lumber and manganese. Macario and other loggers continued to work near the Boqueron River as the region became more populated. When the loggers left at the end of the summer and the rains

came, traffic by animals and vehicles would transform the road into impassable mud that would be washed into waterways. It had to be cut and graded anew every dry season. By the time that Raul and Chevo replaced their wooden *ranchos* with cinder block structures, the loggers had cut all of the big trees near the river and moved higher in the mountains, now working with chainsaws rather than hatchets and handsaws. The increased distance between logging sites and the river made extracting logs that much more difficult, so the loggers worked to improve the road to make it passable by trucks. They embedded wooden poles in the road to stabilize it – creating what is called a corduroy road.

The *Transportistas*

"Movement, there was always movement," Andres said. We were sitting in front of his house perched on a hilltop above the Boqueron River. His deceptively simple characterization of life around the canal and the highway resonated with what others also told me. Look, he explained, if people didn't work for the canal, they worked in agriculture or fished. Many people did both, moving between social worlds – rural and urban, wage labor and agriculture, English and Spanish – but also between functional and crumbling infrastructure. Mobility depended upon transportation across a region fragmented through the construction of the canal, a system built to channel people across, not around, the isthmus. Therefore, regional transportation has depended on the *transportistas*[325] who have made a living driving boats, pick-up trucks, *diablo rojos*, and

[325] Decentralized transportation labor has a long history in Panama. During the Spanish colonial era, the economic geography of Panama was organized around three productive activities: labor, mules, and storehouses (Castillero-Calvo, 1973). Three local groups, in turn, were produced by and benefitted from the institutionalized of transit in the system trade fairs and galleons: the commercial class, storehouse owners, and *transportistas*. *Transportistas* moved foreign wealth by mule over the camino real, the paved royal highway that ran just east of Boqueron. They moved it by boat up and down the Chagres River. During the transportation boom of the mid-nineteenth century, which was associated with the California gold rush, local people benefited more than urban elites (McGuinness 2008). The subsequent completion

taxis. These are the men and women who know local transportation routes – and their potholes and eddies – intimately. Their knowledge and labor serves to bridge formal and informal transportation infrastructure, making it possible for poor people to move across these boundaries. So, if mobility in the transit zone is about these routes, it is also about *transportistas* like Luis.

Luis Segura lives in a small yellow house set back a hundred yards from the gravel road to Boqueron. The afternoon we first met, the sky was darkening. Low rumbling thunder suggested an afternoon rainstorm. His lean eighty-six-year-old frame was splayed out across a hammock above a concrete slab patio. A group of tan hens pecked at dried corn on the floor. Luis was born in 1922 near Cativa, outside of Colon, where work on the *Transístmica* would begin two decades later. His father Raul moved there from the interior province of Veraguas to farm. Like many men of his generation living in rural areas around the canal, Raul was made a living in the banana business. He worked as an independent buyer (*comprador*) for the US-based Standard Fruit Company along the *Transístmica*. Small farmers traveled from their farms down to the highway to sell their bananas. Luis and a small group of men worked under Raul. Their two-day buying route along the *Transístmica* and emerging road system during the 1940s would run from Madden Lake to the Atlantic Coast below Colon. Soon, Luis saved up enough money to buy his own truck to buy bananas. The regional banana industry crumbled during the 1950s. Raul moved to Boqueron to farm. Luis continued to take various kinds of work along the highway in the years between. Most of it involved driving trucks, tractors, and cars.

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of the railroad and, later, the canal had the effect of centralizing transportation and disenfranchising independent carriers who had previously profited from moving foreigners between the oceans.

He followed his father to Boqueron in the mid-1960s. He recalled that his emergence as the local *transportista* began during a long boat trip. He was paddling a boat across Madden Lake with Chevo, the farmer who had settled in the area just after Raul. They left Boqueron early in the morning and arrived at the *Transístmica* late in the afternoon. "I am going to buy a motor," Luis remembered announcing during that long trip. He realized that there was money to be made transporting people and their agricultural products over the lake to market. But he didn't have the money to buy a boat motor. There were loans available to rural people that agreed to work with buyers higher up the commodity chain. Luis approached an Ecuadorian man who bought agricultural products in Vigia with the proposal and he agreed to loan him the money to buy a motor if he channeled local agricultural products to him for purchase. The Ecuadorian gave Luis a key so he could drop off agricultural products at the house in Vigia. He then paid another man to carve a boat from the trunk of an *Espave* tree. Luis brought many of the colonists to Boqueron and, after they had settled, brought them and their products – mainly agricultural, but also wood – to sell in Vigia or to be carried by car to markets in Colon or Panama. The road to Boqueron was still a *camino de verano*. The road became passable by truck when a year-round road was built to the old manganese mine in Boqueron in the early-1970s. Again, the regional political economy of extraction, linked to transnational markets, changed local mobility. Luis took the money that he had saved through his boat and bought a four-wheel drive pick-up truck.

The road to Boqueron is still gravel. It is more stable now but still washes out during the rainy season. Power lines have just arrived, nearly 80 years after they arrived at the Panama Canal hydrographic station visible from the center of town. Roads and

power lines are tangible, specific manifestations of what social scientists often describe as "structural" inequities. They provide a localized means of rendering visible relationships with people and places that shape this small place from a distance. But I have argued that a road is also more than a symbol, more than a reflection of preexisting social, economic, or political relationships. It is a relational space. In Boqueron, people recognize that roads both reflect and reproduce social relationships.

CONCLUSION

Why is it so hard to get around a region organized around transportation? The quick answer is that transnational connection and regional movement are not independent of one another. Mobility and immobility on the isthmus are both the byproducts of networked infrastructures that channel people and materials along routes that reflect the priorities of the communities that build and maintain them. My historical analysis of the debates around and construction of a critical highway demonstrates that interoceanic transportation has been an issue in Panama for at least 150 years. The Panama Railroad had a legal monopoly on routes between the oceans, which was purchased by the Panama Canal at the beginning of the twentieth century. The construction of the canal further troubled regional mobility by dividing the isthmus and flooding land routes.

Transportation surfaces mediate relationships between people across space and time. The word road – or *carretera* – does not capture the variety of land route classes that populate the *campesino* vocabulary in Panama. *Trocha* (trail), *corte* (cut), *carretera* (paved road) each referring to a transportation surface, a width, a seasonality, and a community. The social relationships around roads become visible over time through the

presence and absence of maintenance work. For example, I asked Luis about the difference between a cut and a road. He says that the difference is the groups of people involved in its maintenance. The summer road (*camino de verano)* to Boqueron was opened up only once per year, when loggers from the outside came to the river valley to cut down forests. Now there is a year-round gravel road, but people do not take it for granted. They do political work to keep it up – pressuring their local representative (*representante*) – and, when the state does not maintain the road, the community raises money and creates work collectives to repair a broken bridge or impassable section. The history of the road between Boqueron and the *Transístmica* throws light on how the canal system constrains local possibilities for mobility and also how people build worlds around its edges.

V. FORESTS: MAKING NATURAL INFRASTRUCTURE IN THE PANAMA CANAL WATERSHED

When do plants become water management infrastructure? Francisco Ramos, a forest guard with Panama's national environmental agency (ANAM), answers that question on a daily basis. When I walked into a regional ANAM office located in the upper Panama Canal watershed,[326] Francisco – an athletic fifty-year-old in a khaki uniform with short black hair – was at his desk. But he spends much of his time in the field. He has inspected forest growth on farms in the Chagres National Park since its establishment in 1984. On small farms within the park, he and other forest guards examine the secondary growth of grass, bushes, and young trees that rural Panamanians call *rastrojo* in order to determine when it becomes a forest under state protection. The legal distinction between potential farmland and protected forest is five years of growth, so young *rastrojo* can be cleared and farmed, but older secondary forest cannot.[327] "Before, when there was no park," Francisco said, "farmers were only required to get permission to cut and burn. And it was easy to get. There were no restrictions on the age of the *rastrojo*. Now, they are only allowed to cut up to five years." I asked how he

[326] In this chapter, I use the terms watershed and drainage basin interchangeably. 'Watershed' entered English at the beginning of the nineteenth century from the German *wasserscheide*, or water-parting (Oxford English Dictionary 1989). The English usage of the term, like German, originally referred to the boundary line dividing drainage basins. By the late-19th century, however, watershed increasingly referred to 'the whole gathering ground of a river system,' which is how it is used in this chapter. The watershed is perhaps the key unit in contemporary environmental management and planning, but few in-depth studies of the scientific and political history of the concept have been written. Older works drawing on relatively limited secondary sources include: Smith (1971), and Teclaff (1967).

[327] This distinction was legally established in Panama's Forestry Law 13 of 1987. The law prohibited cutting of all primary and secondary forest (i.e., *rastrojo*) more than five years old. The law was implemented and enforced by INRENARE, the national environmental management agency that was the predecessor of ANAM. Rastrojo is generally understood to be secondary growth anywhere between three and fifteen years after land is cleared.

determines a *rastrojo*'s age. He explains that, through experience, a guard can to learn to interpret the qualities of the plant – its form, its hardness – against the fertility of the soil. If the soil is poor, for example, it takes longer for *rastrojo* to recuperate. The intimate ecological and social knowledge exemplified by forest inspections exemplifies the work of making natural infrastructure for the Panama Canal.

* * *

The past decade has been marked by an infrastructural turn in environmental management and strategic land-use planning. Multilateral institutions, state agencies, conservation organizations, and private firms have adopted the discourse and practice of building "natural," or "green," infrastructure.[328] Even if the term natural infrastructure is not used explicitly, diverse actors now conceptualize particular landforms (forests, wetlands, reefs, and barrier islands, to name a few) in terms of the environmental services they provide. But natural infrastructure is not simply nature "out there." Any technical system is arguably built upon a natural foundation. Water supply systems, for example, harness gravity to move liquid. However, in the words of its promoters, natural infrastructure must, like any infrastructure, be "built," "made visible and functional,"

[328] The promoters of the natural infrastructure approach are diverse. They include multilateral institutions (United Nations Environmental Program, European Commission of Environment), state agencies (US Environmental Protection Agency), conservation organizations (International Union for Conservation of Nature, Nature Conservancy), and private firms (Bank of Natural Capital, Booz Allen Hamilton Consulting). What counts as green or natural infrastructure? Examples include soils and forests in watershed uplands, rivers, urban green spaces, floodplains, mangrove forests, reefs, and barrier islands (Benedict and McMahon 2006, Smith and Barchiesi 2009). However, more significant than the landforms themselves are the environmental services that, through strategic planning and integration, they are understood to provide to human communities: water storage, purification, and conveyance; flood alleviation; improved air quality; outdoor recreation; and climate regulation.

"invested in," or conceptualized as "part of a portfolio." In other words, making natural infrastructure takes work: calculation, representation, translation, and enclosure. This political work involves forging new human-environment relationships and disrupting existing ones, yet ecological distribution conflicts[329] are rarely discussed. In this essay, I theorize the concept of natural infrastructure and analyze the practices and politics involved in reorganizing landforms to deliver environmental services. I engage elements of two literatures, infrastructure studies and political ecology. I develop my argument through a case study of the water management infrastructure of the Panama Canal, examining why, how, and to what effect a region was transformed from agricultural frontier to managed watershed.

* * *

Forest inspections in the Panama Canal watershed are not about forests, per se. Instead, they are bound up with a critical extra-local concern: the canal's water supply. As we concluded the interview, I mentioned to Francisco that in some of the rural communities where he works, farmers told me that they bear the burden of environmental regulation in the park, while other groups – the government, shipping companies, and the Panama Canal Authority – benefit.

The claim seemed to strike a nerve. He rummaged around his desk, found a document, and read: "To preserve the natural forest for the production of water in quality and quantity sufficient for the normal functioning of the Panama Canal, as well as domestic, industrial, and hydroelectric uses in Panama City, Colon, and Chorrera."

[329] Guha and Martinez-Alier 1997.

He finished reading and said, "The principal objective of this park is this – to produce water – it's clear. This has been a struggle for the people who have been restricted. Every time we have a meeting and try to do something, they say: 'We take care of the canal, but the canal doesn't give us anything.'"

"What do you say to them?," I asked.

"You can't say that. You aren't seeing that you have a big television, you have an electrical plant, a new school. All of these goods come from the canal. You are waiting for them to come and say 'take twenty dollars, it's a product of the canal.' No. The benefits of the canal that you'll receive are goods and better education for your kids!"

He paused and then continued: "But the people don't want that, what they want to see is money every year."

Two images flickered in my mind as I drove back toward the small mountains where forests have, for thirty-five years, been managed to "produce" water for a canal downstream. In one image, Francisco inspects a bright green hillside patch of *rastrojo* surrounded by rows of *yuca* plantings and speaks with a *campesino* in a straw hat. In the other, a freighter as long as a skyscraper clears the Miraflores Locks and moves south into the dark blue water of the Pacific.

* * *

As I explain in Chapter 1, fifty-two million gallons of fresh water are released into the Atlantic and Pacific Oceans through the passage of each of the thirty-five to forty-five ships that transit the Panama Canal daily. In that chapter, I examine the configuration of technologies, institutions, human labor, and non-human nature assembled to consistently deliver the enormous volume of water that that floats ships through the canal. In this chapter, I am concerned with the form and consequences of an

emerging form of regional water management. This includes, of course, the "traditional" technologies – dams, locks, and hydrographic stations – built to manage water during the early-twentieth century. These concrete and steel forms correspond with the popular conceptualization of infrastructure as technical system. Over the past thirty-five years, however, a kind of natural infrastructural work – governing relationships between forests and their human inhabitants – has also come to be understood as critical to supplying the canal with water.

My theoretical objective in this chapter is to develop *natural infrastructure* as a heuristic device for understanding the practices and politics of reorganizing landforms as support systems for large-scale political-economic projects. It may seem peculiar to refer to soils and forests in terms normally reserved for electrical systems, railroads, and computing. However, conceptualizing particular landforms as infrastructure – or built socio-technical support systems – is ever more appropriate as a wide range of contemporary actors scramble to define, manage, and profit from ecosystem services. There is a growing sense among politicians, economists, and others that nature is the ultimate infrastructure and should be managed as such.[330] I argue that the conceptual tools developed in science and technology studies to study infrastructure can be combined with insights from political ecology to theorize the shift. Natural infrastructure, like that made of concrete and steel, is embedded with politics. The construction of infrastructural landforms entails the restriction of alternative forms of land use. It both enables and disrupts other projects. But building natural infrastructure also differs in significant ways from, say, roads. The objects of new designs – in this

[330] See Edwards 2003: 196.

case, forests – are bound up in webs of affective and economic relationships that pre-exist their identification as matters of extra-local concern. Natural infrastructure is built upon expert environmental knowledge, but its creation is irreducible to the top-down application of new technologies of visibility and valuation. "Because infrastructure is big, layered, and complex," Bowker and Star write, "and because it means different things locally, it is never changed from above. Changes take time and negotiation, and adjustment with other aspects of the system involved."[331] In practice, making natural infrastructure requires translational work: navigating webs of interdependency, aligning incongruent definitions and boundaries, and negotiating responsibilities.[332]

ORGANIZATION OF THE CHAPTER

The chapter is organized in four sections. First, I bring together literature from science and technology studies and political ecology to develop a framework for studying natural infrastructure. Second, I summarize the assembly of a suite of "traditional" water management technologies during the early-twentieth century.[333] Collectively, these civil engineering technologies transformed the volatile flows of the Chagres River system into a generally[334] knowable and manageable water source for the canal. Third, I examine the establishment of the Panama Canal watershed – a hydrologic basin drained by six major rivers flowing into the waterway – as an administrative region during the 1977-1999 transfer of the Panama Canal and Canal Zone from the US to Panama. Whereas canal

[331] Bowker and Star 1999, 35.

[332] I mean translation as alliance-building in the classic actor network sense (Callon 1986, Callon and Latour 1981), although, in some cases implementing watershed management also involved translation in the linguistic sense.

[333] The history of the canal's water management network is described in detail in Chapter 1 of the dissertation.

[334] See chapter 1 and, in particular, the discussion of the flood of December 2010 as an exception.

administrators had previously emphasized the control of water in its liquid state, watershed management was an attempt to manipulate water flows by managing land cover and use in populated forests located more than twenty-five miles upstream from the shipping lane. Finally, the chapter concludes with an empirical discussion of the politics of natural infrastructure.

NATURE AND/AS INFRASTRUCTURE

As I explain in the introduction to the dissertation, infrastructure is the collective term used to describe the subordinate parts of a "higher" system, often a society or an economy. The term has generally been used to refer to physical support systems that facilitate the flow and distribution of people, materials, energy, and information. However, as use of the concept has proliferated in recent decades, it has increasingly been applied to both this "hardware" and "soft" social systems.[335] Non-human life and landforms are a new frontier for thinking in terms of infrastructure. For example, "green infrastructure" is a concept ascendant in North American planning and land conservation circles. It has been defined as "an interconnected green space network…planned and managed for its resource values and for the associated benefits it confers to human populations."[336] This approach emerged in a historical and governmental context distinct from the processes and programs explored in this chapter. While green infrastructure is couched in the neoliberal language of green finance, my research on the water management infrastructure of the Panama Canal focuses on state-led projects. But, that said, my arguments about natural infrastructure are an attempt to theorize disparate

[335] See, e.g., about education (Twigg 1994), governance (Globerman and Shapiro 2002), computing (Foster and Kesselman, 2004), and public health (Baker et al. 2005).

[336] Benedict and McMahon 2006.

efforts to reorder "natural" landforms as political-economic support systems through planning and management. They might be modified to study projects that have emerged under different conditions.

I argue throughout the dissertation that the infrastructure studies literature developed in science and technology studies can be combined with recent thinking in political ecology to make sense of contemporary environmental problems. I call this framework the political ecology of infrastructure. The specific problem that concerns me in this chapter is an emerging effort to remake landforms as technical support systems – or to build natural infrastructure. The construction of any new infrastructure threatens to transform or eradicate existing ways of life. Natural infrastructure is no different. Its objects cannot be incorporated into new systems in isolation because are bound up in existing socio-ecological relationships. This raises important questions around who is able to access and benefit from the non-human world. In the case of provisioning the Panama Canal with water, the forests that became a matter of concern for watershed managers were – as I will show – already morally, economically, and ecologically bound up in rural agrarian life. Thus, natural infrastructure is not simply identified, but made.

ASSEMBLING THE PANAMA CANAL'S WATER MANAGEMENT NETWORK

This chapter focuses on the new, socio-ecological forms of water management that emerged during the final decades of the century. But neither the emerging experience of water scarcity in the late-1970s and early-1980s, nor the proposed solution – watershed management – can be explained without a basic understanding of the aging technical system that the new Panamanian administrators of the canal inherited from their

US predecessors at the time. The suite of water management technologies that created a working Panama Canal during the early-twentieth century is described in detail in the first chapter, but I want to emphasize one critical point again here. The 1906 decision by the United States government to build a lock – rather than sea-level – canal fixed the enormous volume of fresh water required for every transit and shaped the reorganization of the Chagres River system via dams and locks.[337] Gatun Lake and Alhajuela Lake, large artificial reservoirs, were created to store water and control its flow through the canal system. A century later, the water volume required per transit remains the same, but traffic has increased significantly, from five thousand ships in 1924 to over fourteen thousand today.[338] Thus, infrastructure designed and built a century ago still shapes the management of the transit route and surrounding landscapes in significant ways.

The initial assembly of the Panama Canal entailed two connected types of infrastructural work: civil engineering and human depopulation. On the one hand, a region's physical geography was reorganized over time according to the water demands imposed by the lock design, the climatic and hydrological specificities of Panama, and the increasing volume of traffic passing through the waterway. As water flowed downstream, a network of water management technologies were built further and further upstream. The major human story of the early-twentieth century was displacement and dispossession from the US Canal Zone. Water management and governance were considered distinct issues and fell within the purview of different canal institutions. The

[337] Most water flows out of the Canal system via the locks, but it also exits through the Gatun Dam spillway and hydroelectric turbine, through a system that diverts it for consumption in the terminus cities, and evaporation.

[338] Panama Canal Authority 2010, transit statistics, www.pancanal.com/eng/op/transit-stats/index.html

Panama Canal watershed was a geo-hydrological, not an administrative, region. It was the concern of hydrologists and engineers. This changed during the final decades of the century when water management was redesigned to incorporate nearby forests and extend responsibility for water provision to the *campesinos* that lived in and used them.

MAKING THE PANAMA CANAL WATERSHED

In the 1970s, a new water management problem circulated through offices and conference rooms in Panama and the US. The canal had long been extolled as modern man's ultimate triumph over nature. But now it seemed that the tables had been turned. Foresters and hydrologists suggested that, without decisive action, the environmental degradation of the Panama Canal watershed would put the critical shipping route out of business.[339] The problem was articulated most forcefully by tropical forester Dr. Frank Wadsworth at the 1978 US Strategy Conference on Tropical Deforestation, co-sponsored by the State Department and United States Agency for International Development (USAID). In a paper entitled "Deforestation: Death to the Panama Canal," he argued that deforestation by shifting cultivators – *campesinos* – altered runoff from the watershed into the canal system, depositing sediment in the upper reservoir, and significantly reducing the available water supply. Wadsworth described the anatomy of an emerging crisis:

> In May of 1977, the passage of an above average number of ships, an increased use of water for hydroelectric power and the domestic supplies of growing cities, and the production of timber, food, and forage crops within the Canal watershed led to a dramatic demonstration of the limits of the capability of the water system.

[339] The shift can be associated with a larger realignment of nature and culture in which technological advances were no longer understood to be progressively liberate humans from the constraints of the environment, but, in some cases, to bind us more closely to it. See my discussion of environment, technology, and culture in the introduction.

> The surface of Gatun Lake dropped to 3.1 feet below the level required for full Canal use. Some ships sent part of their cargo across the isthmus by land, reloading it at the other coast, and certain bulk cargo shippers even abandoned the Canal, sending very large carriers around the Horn. In 1977, this predicament coincided with a serious drought, and this was seen as a harbinger of what could soon take place every year. Water consumed for power and domestic needs drains the lake. Deforestation and cultivation in areas adjacent to the headwaters accentuate both flood losses through the spillway and low flow in the dry season.[340]

My strategy for entering the tangle of engineering technology, environmental science, and geopolitics around the Panama Canal during the last quarter of the twentieth century is to retrace the work of Frank Wadsworth as he wove institutional alliances around Panamanian forests in his travels from Puerto Rico, to Panama, to Washington DC, and back to Panama. These alliances connected the canal's water management network with new people and places – as well as alternative institutional and scientific genealogies. The problem, in his formulation, could not be fixed through established civil engineering approaches to water management. Wadsworth thus rejected technical proposals to increase water storage capacity as stop-gap measures. "Only forests," he concluded, "can restore and stabilize the capacity of the canal. Even if Madden Dam were raised, the five additional dams built, fresh water tunneled from elsewhere, and power and urban water consumption discontinued completely, the effect of continued deforestation would be inexorable. Sooner or later it would mean death to the Canal as a reliable world trade route."[341] By invoking the specter of commercial *death*, Wadsworth assigned the canal a new kind of life. He reframed the waterway as a socio-ecological system – a valuable and surprisingly fragile organism – countering the narrower perception of it as a man-made channel. In his formulation, the heterogeneous character

[340] Wadsworth 1978, 23.

[341] Wadsworth 1978, 23.

of the water supply problem – inextricably social, technical, and ecological – demanded an integrated solution: watershed management.

Forest Hydrology, Institutional Politics, and Watershed Landscapes

Watershed management would entail the conceptual and geographical expansion of the Panama Canal infrastructure to incorporate the region's forests and the *campesinos* that inhabited them. The forests of the upper watershed were considered the most critical for hydrological purposes. "This area," Wadsworth wrote, "provides about 40 percent of the water for the entire Canal watershed. It is now being invaded by shifting cultivators."[342] Insomuch as a watershed is a "natural fact," it is always defined against other ways of partitioning and managing the earth's surface. The artifice of the Panama Canal watershed resides in its objectification: the accretion of knowledge, technologies, and institutions around an existing drainage basin to make "it" act as desired. Watershed landscapes became infrastructure through practice: the application of knowledge to establish a forest support system that would optimize canal water provision.

Wadsworth's arguments for watershed management in Panama were undergirded by twentieth-century science and older ideas about forest-water relationships that dated to antiquity in Europe.[343] The study of the effects of natural vegetation on climate, water, and soil was studied under the name "forest influences" during the first half of the century and, at the suggestion of Joseph Kittredge, renamed as forest hydrology in

[342] Wadsworth 1928, 23.

[343] Pliny the Elder may have been the first in Europe to write about the hydrological role of forests. In *Natural History*, written in the first century, he observed the impact of deforestation on spring flow and rainfall (Andreassian 2004, 2).

1948.[344] The field of forest hydrology sought to develop comparative data collection methods and analysis techniques to understand the relationship between land cover and hydrological processes – precipitation, streamflow, evapotranspiration, flooding, drought, erosion, and water quality – that had previously been understood through observation and historical anecdote.[345] James McCulloch and Mark Robinson identify three prominent historical myths about forest-water relationships: 1) forests "make" rain, 2) forests reduce floods and erosion, and 3) forests augment low/dry season flows.[346] All three of these so-called myths remain, to varying degrees, contentious and/or unresolved issues in contemporary forest hydrology.[347]

The scientific verifiability of these so-called myths has not reduced their political utility. They have shaped environmental and social policy for centuries. Concerns about climate change, erosion, and flooding prompted the first localized prohibitions on forest clearing in sixteenth-century Europe.[348] In 1860, France became the first state to

[344] Kittredge 1948.

[345] For example, The American proto-conservationist and watershed management advocate George Perkins Marsh suggested in 1864 that "it is well established" that forests protect spring flows ([1864] 2003, 171) and his own "recollections." The first quantitative paired watershed experiments were conducted at Wagon Wheel Gap, Colorado during the 1920s (Bates 1928).

[346] McCulloch and Robinson 1993, 192.

[347] First, there is no experimental evidence of increased rainfall following the conversion of bare or cultivated land into forest (Calder 2006, Hamilton and King 1983). Second, the effects of forest cover on erosion remain inconclusive. While natural forests seem to limit erosion, the effect appears to be site- and species-specific (Calder 2006, Kaimowitz 2004). Finally, there is no scientific consensus on the relationship between forests and low/dry season flows (Kaimowitz 2004, McCulloch 1993). Forests improve water infiltration and replenish groundwater reserves, which should translate to greater water availability in the dry season. However, a review of 94 paired watershed experiments found no evidence that the reduction of forest cover led to reductions in water yield, nor any in which increases in cover led to increases in yield (Bosch 1982, 16). Which of these effects dominates seems to be largely contextual, depending on a combination of factors including rainfall regime, soil type, and land use.

[348] McCulloch and Robinson 1993, 193.

mandate watershed afforestation.[349] In the twentieth century, foresters acquiesced to the political use of some questionable claims about hydrologic relationships because the rhetoric was used to protect forests.[350] Lawrence Hamilton and Peter King have cautioned that, while well-intentioned, these claims may produce a backlash against foresters and conservation if watershed forests are protected, but flooding, droughts, and the silting of waterways continues.[351] Natural resource access and distribution issues may also provoke backlashes. For example, the French afforestation law of 1860 impoverished a peasantry that had been dispossessed of traditional pasture and communal land-use rights, foreshadowing tensions around watershed management in late-20th century Panama.

Wadsworth arrived in Panama not an impartial expert, but an embodiment of the institutional and scientific tradition of the US Forest Service. His academic and professional training would have included a background in forest influences and forest hydrology.[352] The Forest Service and Army Corps of Engineers struggled publicly over the efficacy of watershed forests as regulators of stream flow and flooding during the first

[349] Lowenthal 2000, 281.

[350] Kaimowitz, 2004, Hamilton and King 1983.

[351] Hamilton and King 1983, 131.

[352] In an oral history interview conducted by Harold Steen (1993), Wadsworth discusses his professional career and philosophy on forestry and natural resource management. Although neither forest hydrology nor the 'sponge effect' are discussed specifically in his interview with Steen, the views expressed in Wadsworth's 'Deforestation – Death to the Panama Canal,' resonate with common understandings of forest-water relationships in twentieth-century US forestry. This is not surprising. In his analysis of the forests and stream-flow controversy, Dodds writes, 'This thesis, widely publicized in manuals of forestry, popular and technical conservation journals, and in the general press, was further disseminated by forestry organizations and sympathetic politicians skilled in advocating their views in the mass media' (1969: 59). Wadsworth was a veteran tropical forester who began working at the Tropical Forest Experiment Station in Puerto Rico in 1942. This was among the US Forest Service's few tropical international outposts. As a doctoral student at the University of Michigan and working forester, Wadsworth was trained in a tradition that emphasized integrated natural resource management.

decades of the century. Rhetorically, the controversy focused on which water management approach – technical vs. "natural" – would create orderly rivers, but this reflected an institutional struggle for the political clout and funding associated with managing water and land.[353] Forestry, by comparison, occupied a marginal position on the isthmus. The Panama Canal Company (which operated the canal itself) and, in many cases, the Canal Zone Government (which governed the enclave around the waterway), were administered by engineers and bound to the Army Corps. The few North American foresters who had worked in the Republic of Panama were conducting scientific research or working as short-term consultants. Their work had little obvious effect on environmental policy or management.[354] There was no forestry training available in Panama[355] and the few domestic foresters, Wadsworth later noted, were "not in the

[353] Between 1908 and 1911 – also the peak years of Panama Canal construction – foresters and their allies framed watersheds as 'natural' political-administrative regions and harnessed anxiety about downstream flooding to garner support a proposed law called the Weeks Act that would authorize the federal government to purchase forested lands upstream in the watersheds of navigable rivers. This brought them into conflict with the Army Corps of Engineers. Kittredge (1948) describes this as a "period of propaganda" by both forest protection advocates and their opponents. Dodds (1969) shows how friction between American foresters and engineers centered on the efficacy of watershed forests as regulators of stream flow and flooding. Gifford Pinchot, appointed first head of the Forest Service in 1905, emphasized the urgent need for regional plans for managing water in conjunction with other natural resources. As no university of forestry existed in the US during the late-nineteenth century, Pinchot had been trained in France – where the forest-water relationship had an established scientific and political history (Kittredge 1948). He had also read George Perkins Marsh's conservation landmark Man and Nature, and was reportedly influenced by the conclusions that the abuse of watersheds and natural resources precipitated the demise of previous civilizations (Glasser 2005, 255). Framing watershed forests as 'nature's reservoirs,' early-twentieth-century US foresters presciently reframed these landforms as vital support system for commerce. They argued that deforestation increases flooding level and frequency, accelerates soil erosion, and alters precipitation, negatively impacting electrical generation, agriculture production, commerce, and natural beauty. Forest cover was described as regulating volatile water flows through the 'sponge effect' – a controversial formulation at the time that remains so to this day (Andreassian 2004, Bruijnzeel 1990, Hamilton and King, 1983; Kaimowitz, 2004; McCulloch and Robinson 1993; Saberwal, 1997). The Army Corps of Engineers publicly critiqued the arguments for basinwide water management, which threatened civil engineering's hegemony over navigation and flood control (Dodds 1969). In the strongest critique, Corps chief HM Chittenden criticized the empirical underpinnings of foresters' claims, arguing that forest cover showed no quantitatively demonstrable effect on flow and might even accelerate watershed runoff (1909). Nevertheless, the Weeks Act passed in 1911 and the Forest Service ultimately managed 25.3 million acres of federal forest reserves acquired under the law.

[354] Pre-1970s research on Panamanian forests by foreign scientists includes: Allen 1964; Cummings 1956, Holdridge and Budowski, 1956, Lamb, 1953, 1959, Pittier 1918, 1931.

[355] Budowski 1961.

loop."[356] I contrast the genealogies of forestry in the US and Panama to make the point that neither the science of forest hydrology nor the practice of managing watershed forests was politically significant on the isthmus before the 1970s. This changed as new alliances were forged that linked the forests around the canal to global commerce and environmental conservation.

Building Alliances around Watershed Forests

Wadsworth's formulation was not simply an act of representation, but of translation. He spoke *for* the Panama Canal and *to* the US government. By framing the watershed problem in a manner that militarily, economically, and morally bound the US to Panama and the future of the canal, he aligned the interests of his audience in Washington DC with the protection of stands of tropical forests thousands of miles away. The institutional actors that initially assembled around the watershed problem were not collectively concerned with shifting cultivators or forests, per se, but ensuring a consistent supply of water for ships to pass through the canal in the face of water scarcity concerns.[357] The water shortage of 1977, Wadsworth wrote, "was seen as a harbinger of what could soon take place every year."[358] The objective of watershed management was thus the mitigation of meteorological and hydrological risk, a problem that introduced serious issues of tractability. How – and where – do you manage an invisible environmental process that confounds human temporal and spatial scales?

[356] Steen 1993, 86.

[357] In science and technology studies, the emergence of water scarcity as an environmental category in relation to the state has been theorized and examined empirically by Samer Alatout (2008, 2009).

[358] Wadsworth 1978, 23.

The conservation of watershed forests became water management by proxy. Forest management meant that groups from disparate social worlds in and beyond Panama came into contact with one another. Susan Leigh Star and James Greisemer developed the concept of "boundary objects" to explain how groups work cooperatively across socio-cultural difference.[359] Ideally, boundary objects are abstract enough to adapt to diverse viewpoints and projects, but concrete enough to maintain a common identity across sites. Recognizable and actionable in a way that weather and water were not, representations of Panamanian forests served as a locus for water management during a moment of rapid geopolitical change, facilitating the establishment of transnational alliances. Boundary objects are essential for building natural infrastructure for systems like the Panama Canal that depend on cooperation across social worlds. But, as I argue below, organizing around poorly defined "natural" objects may ultimately reveal problems of asymmetrical power relations around resource distribution.

The 1970s and 1980s were not only a period of rapid geopolitical change on the isthmus, but a time when watershed management and forest conservation were ascendant topics in international academic and economic development communities. Stanley Heckadon-Moreno, a Panamanian sociologist who played a key role in early watershed management efforts told me that the watershed concept arrived in the country via foreign institutions. Reflecting on its ascendance, he recalled, "In Panama the word watershed – *cuenca* – didn't exist. People knew about the canal. But when one spoke about a *cuenca*, nobody had the slightest idea what you were talking about…I think the word began to come into vogue in the seventies and definitely in the eighties, used by institutions like

[359] Star and Greisemer 1989.

CATIE [Center for Tropical Agronomy Research and Teaching] in Costa Rica…The concept of using the watershed as a [political] geographical unit – not a country, not a province, or a state or a *corregimiento* [county] – but a river. That was new."[360]

Wadsworth's translational work extended the reach of tentative efforts underway in Panama to manage the watershed. He collected the material for his alarmist essay in 1977 while consulting on the development of a USAID program designed to strengthen the technical and administrative capabilities of Panama's historically insignificant and impoverished natural resource agency (RENARE).[361] His argument was not based on original research. USAID had previously funded the research of Dr. Clark Larson. Larson, an agricultural engineer, found that deforestation in the watershed for cultivation and pasture increased the sedimentation of the canal and reduced water storage capacity.[362] Wadsworth later reflected on his arrival in Panama and the paper that emerged. He said to an interviewer, "I saw a report by somebody before me, Larson I think…pointing out some of the critical watershed things about the area. I put it all together in a speech I made at the State Department in Washington. I titled it 'Deforestation: Death to the Panama Canal.' That received a great deal of notoriety, not only in the US but it was translated by Hekadon [sic.] in Panama into Spanish. I think it led AID to spend more on the canal."[363]

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[360] Heckadon-Moreno, interview, 8 October 2009. Transnational networks of environmental expertise are documented in the annual reports of Panama's Ministry of Agriculture and natural resource agency (RENARE) throughout the 1970s and 1980s. I also interviewed several Panamanians working at RENARE during this period who supported Heckadon-Moreno's claims.

[361] Wadsworth, 1978, 24.

[362] Larson 1979.

[363] Steen 1993, 68-71.

Watershed Maps and the New Environmental History of the Panama Canal

Actor network theorists have argued that documents circulate through material channels and matter to the extent that they establish connections between actors and sites.[364] Panamanian forests traveled to new places via texts and maps. Two forest cover maps – one from 1952 and the other from 1978 – supported Wadsworth's speech in Washington, providing striking visual evidence of the rapid deforestation of the Panama Canal watershed. The dwindling green forests depicted on the maps established a link between the specific water scarcity concerns of the canal and emerging global environmental concerns. Representations of rural deforestation within the watershed linked specific environmental problems around the waterway and general problems of environmental degradation across the global tropics. In the discussion that followed Wadsworth's presentation, for example, audience members agreed that forest conservation was not – counter to previous orthodoxy – an impediment to economic development in the tropics, but necessary to its realization. The discussion concluded: "because of the importance of the Panama Canal to world commerce, universal concern and action could result in saving the waterway, thus making the Canal a prototype for the application of necessary solutions."[365]

Even a cursory analysis of the reams of scientific and policy-oriented documents about the management of the canal watershed available today reveals a common environmental narrative. When the canal was first reimagined as a techno-ecological system during the late-1970s, it had to be assigned an alternative genealogy. In this

[364] Callon, Law, and Rip 1986, 10-12.

[365] Wadsworth 1978, 25.

history, 1952 – the date of the first watershed map, rather than the 1914 opening of the waterway – became the baseline year. "Originally covered with dense rain forest and still 85 percent forested as recently as 1952," Wadsworth said in his presentation, "some 250,000 acres, or 35 percent, of the Canal watershed have since been deforested."[366] Deforestation seems to begin in 1952 and, in many cases, is illustrated by the same crude map. This map, made by a Panama Canal employee named Frank Robinson, has become the Panama Canal watershed's ur-text. Frank Robinson described the map to a US government interviewer in 1982. "The green depicts more or less what is left forested, this orange area is the little boundary. This is your watershed. In the pink or reddish part is [sic] areas that has been cut over and the original forest gone."[367]

Robinson created the original watershed map in 1952, his first year as an employee of the Panama Canal Section of Meteorology and Hydrology. He was a recently married veteran of the Second World War in his late-twenties. His new job was to collect hydrographic data from stations that the Section managed across the watershed. Robinson was personally drawn to the forests of the upper watershed. "When I first came to work here," Robinson said, "I was a young knucklehead and I loved the bush."[368] He was not a cartographer and his work responsibilities did not include the creation of a forest cover map. Forests were not the concern of the hydrologists employed by the canal. The rivers and lakes of the watershed were under US jurisdiction, but all forests beyond the Canal Zone were under Panamanian control. This is why Robinson chose to

[366] Wadsworth 1978, 22.

[367] Interview with Frank Robinson, July 7, 1982, Records Relating to the History of the Implementation of the 1977 Panama Canal Treaty [Agency History Files], 1968-85, NACP RG 185, Transcripts through Miscellaneous History Papers, Box 1.

[368] Interview with Frank Robinson, July 7, 1982, p. 11.

isolate the watershed – half in Panama, half in the Canal Zone – from its political geography in 1952: "During the political days I would only put the watershed [in the map], because it was none of my business what was happening here [in Panama]."[369] The watershed on the map – the shape of a breaching whale – was an alternative geography. It seems to elide geopolitics even as it testifies to their environmental importance. Most of the watershed was forested, but red deforested areas clearly identify the Panamanian side of the boundary.

In 1972, the Section of Meteorology and Hydrology hired Luis Alvarado, a young Panamanian hydrologist. Alvarado was interested in the environmental changes that Robinson had been mapping for two decades around the stations where the Section collected hydrographic data. Robinson became his mentor. Alvarado explained to me during an interview at a coffee shop in Panama City[370] how they made the forest cover maps in the 1970s: "It was done very crudely, simply visual observation out of helicopters when we were picking up [hydrological] data…when we were going in, you could see where new forest was being cut. We'd fly with maps and then we'd pinpoint it. No GPS or anything. You knew the river and you knew more or less where the area it was 'that looks like ten hectares' and you'd make a little circle: ten hectares. Very crude but very effective, because over ten years you could see the difference in what was happening."

[369] Interview with Frank Robinson, July 7, 1982, p. 11.

[370] Luis Alvarado, interview with the author, Albrook, June 28, 2008.

The 1952 map became important in relationship to the watershed map that Robinson and Alvarado made in 1978. In this map, deforestation (red) has relegated forest (green) to the roadless margins of the upper watershed. These stark before and after images were picked up and used widely in the late-1970s and early-1980s as the Canal Zone – and, by extension, the entire watershed – was reverted to Panamanian control: by Wadsworth, in a USAID country profile, and, by 1982, by a student at the Florida State University branch in the Canal Zone. Read against one another, the maps distill complex socio-ecological changes into a neat, two-frame declensionist narrative: forests had disappeared and would soon be completely gone.

The maps arguably misrepresent the history and geography of the watershed. It is easy to interpret the heavily forested baseline image (the 1952 map) as representative of historical land cover. Beginning with this assumption, the arc of an environmental declensionist narrative (from primary forest to degraded land) appears linear and can be projected forward to justify political interventions in the present. However, scholars tell us that such a reading of pre-1952 environmental history is inaccurate. Forest cover in the transit zone follows a non-linear pattern, marked by periods of deforestation and reforestation prior to European contact.[371] In fact, Charles Bennett argues that the period between the arrival of the Spanish and the beginning of the US canal project (1501-1903), was "marked by the ecological retreat of man [indigenous people on the isthmus had altered landscapes through agriculture] and the reestablishment of forested or wooded conditions over much of the isthmus."[372] Geographically, the boundary lines of

[371] The best work of historical geography or historical ecology related to forests remains Bennett 1968.

[372] Bennett 1968, 55. See also the discussions of historical land cover change in works by Panamanian environmental historian Guillermo Castro Herrera (2005, 2007) and geographer Omar Jaen Suarez (1981).

the watershed isolate the region from its broader socio-political and ecological context. They delimit a space that had, in political and social terms, never existed. My objective here is not to debunk Robinson's maps, but to trace how they performed. As a tool for interpretation and action, the boundary lines and the two simple fields of color made a difference. By equipping would-be watershed managers in Panama and elsewhere to make claims and justify intervention, they would slowly begin to reshape the reality they represented. The Panamanian environmental agency, RENARE, requested Robinson's watershed maps in 1976, so their cartography department could produce copies for watershed and forest management purposes.[373]

RENARE had already begun to compile meteorological, hydrological, soil, and social data across the watershed for analysis and prospective management.[374] Their initial efforts were not coordinated with work done in the Canal Zone before the inaugural Panama Canal watershed management program. This program, funded between 1978 and 1983 by a $10 million USAID loan and $6.8 million Panamanian contribution, aimed to establish the basin as a cooperatively managed region. The program also had localized objectives: to increase environmental awareness and "establish watershed management programs**…**that incorporate, to the extent possible, the

[373] Interview with Frank Robinson, July 7, 1982, p. 11; Government of Panama 1976.

[374] Evidence of early watershed management work is scattered across annual reports of the Ministry of Agriculture (Government of Panama, 1973: 330; 1975: 269; 1976:158). Some employees received short trainings by international organizations in watershed management at that same time. Employees also received training from international organizations, e.g. Inter-American Institute for Cooperation on Agriculture provided a one-week watershed management course in 1974 and again in 1975 (Government of Panama, 1975:275, 310). However, most 1970s research on the watershed as an environmental and economic problem appeared in unpublished policy reports written around the signing of the 1977 Torrijos-Carter Treaty. A few published reports from those working at the science-policy interface include: Isaza, 1976, 1978; Larson 1979; State Department Office of Technology Assessment, 1978.

watershed's population into the resource management conservation process."[375] This phrasing – *incorporation of the watershed's population into the resource management conservation process* – marks a significant shift in which groups of actors were ultimately assigned responsibility for the management of the canal water supply. As forested landscapes were assigned a new infrastructural function (water provision), their inhabitants were simultaneously charged with a new responsibility (forest conservation). But this was easier said than done. The region's *campesinos* inhabited a world largely dissociated from the waterway and its transport economy.

THE POLITICS OF NATURAL INFRASTRUCTURE

"Emerging infrastructures," Paul Edwards notes, "invariably create winners and losers. If they are really infrastructures, they eventually make older ways of life extremely difficult to maintain."[376] The establishment of the Panama Canal watershed as an administrative region depended on *campesinos* accepting new responsibilities incompatible with those that the Panamanian state had historically assigned them: agricultural colonization and development. RENARE was a section of the Panamanian Ministry of Agriculture, an institution that had worked throughout the 1960s to modernize agriculture across Panama's rural interior – including the upper watershed – through experiment stations, rural penetration roads, and agricultural extension. The Ministry of Agriculture built the socio-technical infrastructure for the state "Conquest of the Jungle" program that promoted *campesino* colonization of forested frontier zones for

[375] ROCAP-USAID/Panama 1981, 6.

[376] Edwards 2010, 12.

both economic development and political purposes.[377] The topography of the upper watershed had historically made it unattractive for agricultural development.[378] But the Panamanian state pursued regional agricultural development, nonetheless, opening a demonstration ranch in the 1950s to expand cattle production in "a region not commonly considered appropriate for these types of activities" and identifying it as a priority area for national development.[379]

The focus on rural development was amplified significantly after 1968, when the *Guardia Nacional*, the first military government in Panamanian history, took power in a coup. One of the *Guardia'*s public priorities was improving the condition of the peasantry. They particularly emphasized rural land reform programs. *Latifundias* (large estate farms) were expropriated and landless *campesinos* were encouraged to join agricultural cooperatives called *asentamientos*, often on this land.[380] The Ministry of Agriculture's annual reports from the late-1960s and early-1970s reflect this populist, agrarian reform fervor – "Production is revolution! Exploit the land, not the man." Government reports proudly tallied roads built, forests cleared, and new land planted. "The *Guardia Nacional*," Heckadon-Moreno writes, "like other military regimes that came to power in tropical America during the 50's, 60's and 70's, was keenly interested in securing the physical integration of the *selva* [forest] into the nation

[377] Heckadon-Moreno 2005, 37.

[378] Two US American foresters hired by Panama in 1955 to conduct a survey of the nation's agricultural and forestry potential concluded that the steep, mountainous topography could not support permanent agriculture 'at a satisfactory level' and should thus be closed to settlement. They argued, presciently, that these lands were more valuable covered in forest, which would maintain and regulate water sources for more suitable agricultural lands and hydroelectric power downstream, provide timber, protect wildlife, and afford opportunities for recreation (Holdridge and Budowski 1956, 103-105).

[379] Government of Panama 1956, 33-4; Government of Panama 1968, 390.

[380] Heckadon-Moreno 1984, 143.

state…colonization was a fast and cheap way of incorporating the forest into the development process."[381]

This approach changed rapidly within the watershed after the 1977 Treaty began the reversion of the canal and Canal Zone from the US to Panama. The transition was to be complete before the year 2000. The Panamanian state, which had framed watershed forests as blocking economic development during previous decades, now deemed them to be necessary to its achievement. As an environmental support system – an infrastructure – they were valued in a new way. The description under the heading "Beneficiaries" in a 1981 USAID project evaluation is revealing: "Although not specifically stated in the Project Paper the principle sub-purpose of the project is the protection of Panama Canal waterways and water storage systems. The Canal represents Panama's major industry and is at the heart of a complex system of support and service industries closely associated with the Canal. Consequently, the project benefits Panama's major industry and its work force which is increasingly made up of local inhabitants…In a larger context, natural resource protection and management benefits all Panamanians...[382]

What was the "larger context" in which all Panamanians benefited? Forests were understood to produce water, the lifeblood of the canal and its associated transport service economy. But they could not be protected without hurting rural livelihoods. Agriculture employs approximately twenty-five percent of Panamanians, while the

[381] Heckadon-Moreno 1984, 147.

[382] ROCAP-USAID/Panama 1981, 6.

transport sector employs a mere six percent.[383] The Panamanian state re-scripted *campesinos* living in the watershed from development solution to development problem.

Given the rapidity of this shift and obvious tensions between old and new state plans for the region, it proved difficult to convince rural people to curtail agricultural production to protect the Canal's water supply – to convince *campesinos* that the forests they lived and worked in were not exclusively theirs, but part of a hydrological support system for shipping. New watershed managers encountered, at every turn, a rural development infrastructure – roads, agricultural cooperatives, extension agents, agricultural loan programs – that encouraged the very land use practices they now considered economically and ecologically irresponsible. The inertia of that socio-technical system made it difficult to quickly change ingrained patterns. This was because the development apparatus was designed to shape practice and cultivate modern, productive rural subjects. Building natural infrastructure in the watershed thus entailed both navigating an entrenched system and the moral economy – or norms and customs concerning the legitimate roles of particular groups within the economy – that had accreted around it.[384] Managers quickly recognized that the success of watershed management was contingent on enrolling translators[385] able to align the diverging interests of state institutions and rural social worlds – in the idiom of the *campo*. The next section focuses on this quotidian translational work. Because there are few existing

[383] Barry and Lindsay-Poland 1995, 72-73.

[384] The classic formulation of moral economy is Thompson 1971. Bowker and Star argue make a similar claim about infrastructure: "we have argued…that it is politically and ethically crucial to recognize the vital role of infrastructure in the 'built moral environment.' Seemingly purely technical issues like how to name things and how to store data in fact constitute much of human interaction and much of what we come to know as natural" (1999: 326).

[385] Here, again, I am using the term "translators" in the ANT sense (as alliance-builders).

written records on the subject, I draw largely on oral history interviews that I conducted in 2008 and 2009 with forest guards and *campesinos* in the watershed.

The Translational Work of Watershed Management

The political redefinition of populated forests located more than twenty-five miles upstream from the Panama Canal as a living support system for shipping highlights the complexities around allocating the burdens and benefits associated with natural infrastructure. The infrastructural work needed to implement watershed management is very different from building a dam or a road. In Panama, watershed management has entailed the slow, difficult work of forging and maintaining relationships with the rural people whose livelihoods are scripted as a threat to the canal. This process, unlike engineering, is bottom-up. It depends on the participation of new actors that had not previously participated in water management.

Luis "Lucho" Alvarez remembers when he learned about the watershed. We are sipping coffee on the porch of his grey, two-story cinder block house as he recalls that day nearly thirty-five years ago. In 1958, he moved with his family from Panama City to the banks of Madden Lake. Like many settlers arriving at that time, Lucho, still a teenager, dreamt of farming his own land. He knew that he never wanted to work as an *empleado*, or wage-laborer. One day in 1975 he was cutting back the rapidly growing brush – or *rastrojo* – on his farm near Madden Lake, when he received a note that Colonel Ruben Dario Paredes, the Minister of Agriculture, wanted to meet.

> "You've been recommended as a man who is not afraid of anything," Paredes said to Lucho.

> "We'd like to give you a job: we want you to keep the hand of the campesino from destroying the watershed.'
>
> "What is the watershed?" Lucho asked. He had never heard the term.
>
> "The watershed is all of this area that drains into Alhajuela Lake," explained Paredes. "I'd like to do it," Lucho said, "but I have to talk with my wife, my first child is on the way."
>
> Paredes offered a starting salary of fifty dollars every two weeks. "I'm not going to abandon my land for fifty dollars, Colonel," countered Lucho. "I've got an old mother, an old father, a brother – we can't live off of that much money. I'm my father's right hand."

Paredes increased the offer to include a free education in natural resource management. Lucho had no particular interest in natural resources at the time, but he wanted an education, so he accepted. He had, in actor network terms, been *enrolled* in watershed management.[386] Paredes mobilized the promise of career opportunity and education to convince Lucho to put down the machete, leave his farm, and assume the role of forest guard. RENARE initially recruited and trained forty-six forest guards to patrol the watershed.[387] They were, like Lucho, mostly local men who had been identified by officials as leaders respected in their rural communities. This was a strategic decision; it was hoped that hiring guards familiar with the area and its people would facilitate cooperation with watershed management.

The forest guards' initial project was to survey the human population living within the contours of the watershed. Unlike the US surveyors that collected geophysical

[386] Callon 1986.

[387] ROCAP-USAID/Panama 1981, 7.

data on the watershed in the early-twentieth century, the guards spent three years (1975-1978) collecting information about the region's human inhabitants. Survey data, combined with national census data, provided a demographic baseline for the watershed, assigning – for the first time – a human population to the administrative region.[388] Forest guards anticipated a pushback to land use restrictions in rural communities. Wadsworth, who returned to Panama in 1979 to assist with the USAID-funded training of the initial group of forest guards, recalled "They wanted to know what they should do if the mayor of their district was telling people to move in and farm there or if they found him there with a shotgun, what were their rights and so on."[389] A training later that year focused on the translational aspects of watershed management or, as the course certifications read, "methodologies for incorporating the *campesino* in programs of development, conservation, and administration of Panama's natural resources."

Forest guards were then charged with traversing the watershed and translating extra-local concerns about forests, water, and the canal to its new inhabitants, the "shifting cultivators" that Wadsworth had identified as a threat to the trade route. The enrollment of *campesinos* in watershed management was physically demanding for guards. Ironically, the very physical attributes – steep topography, heavy rainfall, dense forest, and a lack of roads – that historically made the upper watershed unattractive for agricultural development now frustrated watershed managers' efforts to restrict farming. Forest guards complained that the watershed was too large and too difficult to access to

[388] Cortez, 1986: 45.

[389] Steen 1993, 69.

be effectively patrolled by their small number.[390] The problems presented by watershed management were geographical, but they were also – perhaps less obviously – cultural.

In practice, watershed management raised questions and issues around the definition of forests. The forests depicted on Frank Robinson's watershed maps existed in only two states: present (green) or absent (red). When actors made the case for forest conservation in urban settings, the referent – areas covered with trees – was clear enough. In fact, the vague definition of the "forest" around the Panama Canal likely facilitated alliances around watershed management. They were an ideal type, a boundary object that "does not accurately describe the details of any one locality or thing…However, it is adaptable to a local site precisely because it is fairly vague; it serves as a means of communicating and cooperating symbolically -a 'good enough' road map for all parties. An example of an ideal type is the species. This is a concept which in fact described no specimen, which incorporated both concrete and theoretical data and which served as a means of communicating across both worlds…They result in the deletion of local contingencies from the common object and have the advantage of adaptability."[391]

Before 1984, when upper watershed lands – about thirty percent of the basin area – were enclosed within Chagres National Park, *campesinos* were legally permitted to cut secondary forest for agriculture with written permission.[392] Watershed management efforts focused primarily on reforestation with exotic tree species – teak, pine, and others

[390] Pinzon and Esturain 1986, 213-214.

[391] Star and Greisemer 1989, 410.

[392] Chagres National Park was declared through the Panamanian government's Decreto Ejecutivo 73 de 2 de Octubre and legally established in 1985 with the publication of the Gaceta Oficial 20.238.

– distributed through a network of RENARE nurseries. Because forest guards at that time were local men who understood *campesino* agricultural systems and maintained personal relationships, agriculturalists were often able to effectively communicate their livelihood concerns to the extension agents of watershed management. Forest definitions were, at that time, negotiable in a mutually acceptable manner and guards gave out licenses easily to cut and burn secondary forest. In 1987, with the passage of Forest Law 13, watershed management took a coercive turn. Guards, now accompanied by soldiers from Manuel Antonio Noriega's *Fuerzas de Defensa* (Defense Forces), explained that *rastrojo* of five years was legally considered forest and could never again be cleared. Violators were fined and had their machetes and hatchets confiscated. Some were taken to jail, provoking outrage in rural communities. "In essence," Stanley Heckadon-Moreno concluded, "the government decided that, in order to save the Canal, the forests had to be protected from the machetes of the farmers."[393]

This is where the previously negotiable boundaries of watershed forests broke down. In everyday encounters between forest guards and *campesinos*, local contingencies could not be deleted from forests. Wet lowland forests are not a stable object, but a heterogeneous process. Once primary forests were cut down – and many had been – the distinction between forest and farm became blurred. Secondary forest serves as fallow in the swidden agricultural system practiced by *campesinos* across much of rural Panama. Within this system, there are three general land cover categories: *monte* (land in cultivation), *rastrojo* (secondary growth from three to fifteen years, considered fallow for future planting), and *montaña* (primary forest). My semi-structured interviews

[393] Heckadon-Moreno 1993, 138.

suggest that even these broad categories differ from one farmer to the next. *Rastrojo*, as I suggested in the introduction to this chapter, was the problematic category, encompassing land covers that range from low brush to what temperate zone visitors may identify as forest. Forest Law 13 imposed a seemingly arbitrary legal distinction – five years – on the processual, messy nature of human-environment interactions around the canal.

Farmers were unhappy with the decision, not only due to aggressive enforcement, but because it changed their fallow practices for the worse. In interviews, farmers told me that the more mature the *rastrojo* is when cleared, the better nutrients provided to the next crop on that land. Consequently, *campesinos* weigh the maturity of a *rastrojo* against the need to put land back into production quickly. Only in desperate circumstances would a farmer clear a *rastrojo* less than five years old. But reduced fallow cycles was precisely what forest laws demanded.

CONCLUSION

The infrastructural work that went into making the Panama Canal watershed is inscribed on the contemporary landscape. There are, on the one hand, markers of a stabilized administrative region. The coercive forest protection tactics of the 1980s – the Noriega era – have been replaced by community-based sustainable development projects like reforestation with native trees, sustainable ranching, and beekeeping. Signs promoting these projects are posted along the edges of the gravel road that runs eastward up the watershed and into Chagres National Park. A disproportionate number of the autos within the park are the late-model pickups of conservation and development professionals. Yet, despite changes in approach, familiar questions of justice persist in

the region. If the history of Panama Canal watershed is legible to local people in presences, like development projects, it is also recognizable through absences on the landscape. During my fieldwork, people recalled neighbors who migrated elsewhere to farm without restriction. They remembered the rise and fall of the local agricultural cooperative (*asentamiento*) that attracted landless farmers from far away to settle what seemed to be an open frontier. They pointed to the infrastructure that arrives slowly, if at all. For example, the community where I worked is within forty miles of the canal and Panama's largest cities – Panama City and Colon – but electricity arrived for the first time last year, decades after the rest of the region. The road is often impassable during the rainy season. In this way, infrastructure renders the logics of distribution embedded in these arrangements visible and raises important questions about the complex relationships between environmental and social responsibility.

In this chapter, I have examined a regional infrastructure assembled to make water circulate through the canal in a manner that meets the transportation needs of global commerce. By bringing infrastructure to the surface, I have sought to ground large-scale political-economic processes (global commerce) in the local-regional practices (water management) that make them possible. Infrastructure is conceptually and geographically unstable. The parameters of critical infrastructure are always changing as the articulation of new knowledge and circumstances redefines "critical."[394] My theoretical objective in this chapter has been to flag and analyze one shift in particular. Drawing on political ecology and what has been called infrastructure studies, I have argued that there is a global push to reimagine and reorder "natural" landforms as

[394] Collier and Lakoff 2008.

support systems for larger projects. Like roads and dams, natural infrastructure is necessarily political. Its organization reflects assumptions about how societies are (or should be) organized and its construction actively produces new social arrangements. In the case of provisioning the Panama Canal with water, the objects of new infrastructural designs – forests – were economically, ecologically, and morally bound up with a development infrastructure that encouraged rural people to act, think, and feel in ways that were opposed to the goals of watershed management.

Despite the current obsession with environmental visualization and valuation, building a working and equitable natural infrastructure ultimately depends translational work. It is about aligning incongruent boundaries, negotiating responsibilities, and allocating responsibilities and benefits. This is a challenging prospect. Over the past thirty-five years, Panamanian *campesinos* have been repeatedly assigned responsibility for canal water, a claim they now deploy in encounters with watershed managers. Because they "care for water" – now recognized as a commodity – by protecting forests, they argue that they should be compensated. They are not working, they argue, so the canal can. This framing calls us to consider how infrastructure, both technical and natural, might be designed and managed in such a way that large technical systems like the canal do more work for their neighbor

VI. CONCLUSION

In *The World Without Us*, Alan Weisman describes how quickly the built, human world that we often take for granted could fall apart. Without the constant behind-the-scenes work of a multitude of engineers, administrators, and laborers, he explains, the Panama Canal's water storage reservoirs would empty as the metal gates that currently contain them rust and fail. The Chagres River would emerge from the canal and follow its former channel north to the Atlantic Ocean. Sediment would clog un-dredged channels. As the Pacific section of the route – where most of the canal excavation took place a century ago – dried up, North and South America would be united once again.[395]

I introduced the dissertation with a critique of the popular notion of the Panama Canal as a "big ditch": a project completed once and for all in 1914. In the case of the canal, the political ecology of infrastructure approach that I framed in the introduction redirects our attention from the global transportation operations that normally capture our attention – the smooth flow of passing ships – to the situated human, technological, and environmental organizational work that makes transportation possible. By bringing the backstage elements of transportation to the surface, I have portrayed the canal as an always-unfinished project that functions and endures only through constant maintenance. However, for the people employed through, or affected by, the extensive system that facilitates transportation across Panama, the "backstage" of global shipping is the fabric

[395] Weisman 2007.

of everyday life. Canal infrastructure sprawls across the landscapes and livelihoods of the region around the shipping lane. But even this characterization is too neat, because it leaves the boundaries between technology, nature, and culture intact.

The canal is a work-in-progress. My use of the word "work" is purposeful because there would be no trade route without the collective work of people, engineering technologies, and the Chagres River. Historian Richard White, like Weisman, underlines the significance of work in his history of the remaking of Washington state's Columbia River as an "organic machine": an entity in flux where, over time, work renders the boundaries between the natural and the human, as well as the material and the social, difficult to distinguish.[396] The agency of the river – widening, eroding, and removing obstacles to its flow in search of an efficient path to the sea – shapes, but does not determine, human decisions about where, for example, to build a dam or establish a community. White writes, "The energy system of the Columbia determined where humans would portage, but human labor created the actual route of the portage and human social relations determined its final social form and outcome."[397] The river shaped human thought and action and, in turn, humans used their technologies to organize a new river. Today, human relationships with Washington's Columbia River or Panama's Chagres River cannot be encounters with pristine nature, but with a built environment where the cultures and politics of the past – materially embedded in the designs of our infrastructures – articulate with rainfall, snowmelt, and earthquakes, and then act back upon us.

[396] White 1995.

[397] White 1995, 14.

The work of a river, regardless of its agency, is clearly distinct from human labor, which is socially organized and ascribed meaning. During the construction of the Panama Canal, for example, most white North Americans (gold-roll employees) held engineering, administration, supervision, and equipment operation jobs, while most black West Indians and Spanish-speaking peoples (silver-roll employees) were low-level laborers. Cultural distinctions were reflected by the differential location of workers' bodies within the organic machine of the canal and the purposeful organization of a segregated human and physical geography "designed to remove white American residents from an array of 'Others', specifically an 'Other' natural landscape (the Panamanian 'jungle'), an 'Other' cultural landscape (Panamanian cities), and an 'Other' people (the West Indian Panama Canal labour force and Spanish-speaking Panamanians."[398] In other words, taxonomies of race, language, and culture shaped governmental decisions about "appropriate" environments for particular human settlements and land use therein.

We do not typically think of transportation in environmental terms. Environmental anthropology research has largely focused on ecologies of extraction, production, and consumption. These critical issues should and will continue to attract attention. What I am arguing against is the notion that transit zones – those in-between landscapes along train tracks, roads, and waterways – are somehow non-places[399]: uniform sites without history, social life, or ecological significance. After all,

[398] Frenkel 2002, 85.

[399] Auge 1995.

transportation infrastructure is local at all points.[400] It is always situated somewhere, even if circulating ships, trains, and trucks are not. On the one hand, this means that the environmental impacts of transportation services are distributed unevenly across space.[401] On the other hand, the standardized nature of transportation systems demands the organization and maintenance of specific configurations of technologies, human populations, and nature.

My dissertation examines this infrastructural reorganization and the natural resource access/distribution conflicts that have resulted in Panama. Transportation projects rework landscapes and, in so doing, may disrupt the livelihoods of those that depend on those environments for other purposes. They also establish new connections. Infrastructures are networked, formatting political-ecological relationships among actors that may be distant in time and space. For example, the Panama Canal's water management infrastructure – especially the water supply demands imposed by the lock design – linked the agricultural livelihoods of small farmers in the surrounding watershed during the 1980s with both the US experts and politicians that made engineering decisions in 1906 and the contemporary global network of consumers, producers, and shippers dependent on the canal. In this way, infrastructure moves us beyond conceptualizing a technology as mediating one group's relationship with one environment, and toward an understanding of how multiple ecologies and social groups come into communication.

[400] "Local at all points" is Bruno Latour's phrase (1994, 117).

[401] For example, the ships that transit the canal are part of a global fleet of 90,000 vessels with enormous, often overlooked environmental impacts. A mere 15 of the largest ships emit pollution equivalent to all of the world's 760 million cars (Vidal, The Guardian, April 9, 2009). These emissions are largely unregulated and disproportionately affect ports and their surrounding regions.

I have developed several claims around this argument in the dissertation. First, infrastructure is a tool for understanding the constitution of relational space. Large technical systems are generally designed and built in a top-down manner, but, over time, they intermingle with the human and non-human communities that accrete around them. Through a multiplicity of small interactions, they slowly become different things. It is the combination of a traceable materiality and an emergent quality – the system changes from below, yet exceeds individuals' capacity to know and act – that makes infrastructure such a potentially powerful heuristic tool for political ecology research. Second, infrastructures are political: their creation and expansion inevitably threatens existing ways of life, creating winners and losers. In this way, the assumptions and biases of system-builders persist long after those people are gone. Because they are such robust sites of quotidian politics, infrastructures are a rich ethnographic subject. For example, I found that many people living in rural communities around the Panama Canal interpreted their changing connections with – and access to – other places and groups through the absence, presence, and maintenance of infrastructure – providing extra-local analyses akin to the reverse anthropology described by Stuart Kirsch.[402] Third, building upon the previous point, we should conceptualize infrastructures not simply as means of connection and communication (crossing boundaries) but sites of convergence, attraction, translation, and negotiation – as boundaries themselves. They are sites of collaboration, contestation, and negotiation, where different systems come into contact. If we approach political ecology in terms of boundary infrastructures, we see that power often operates in a heterarchical fashion. The "global" does not simply act upon the "local," but depends

[402] Kirsch's (2006) ethnography of two political movements in West Papua New Guinea attempts to reverse anthropological conventions by privileging indigenous modes of analysis over those of the researcher.

on the organization of technologies, landscapes, and people at multiple sites to come into existence. The region around the Panama Canal is one site where globalization is made.

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