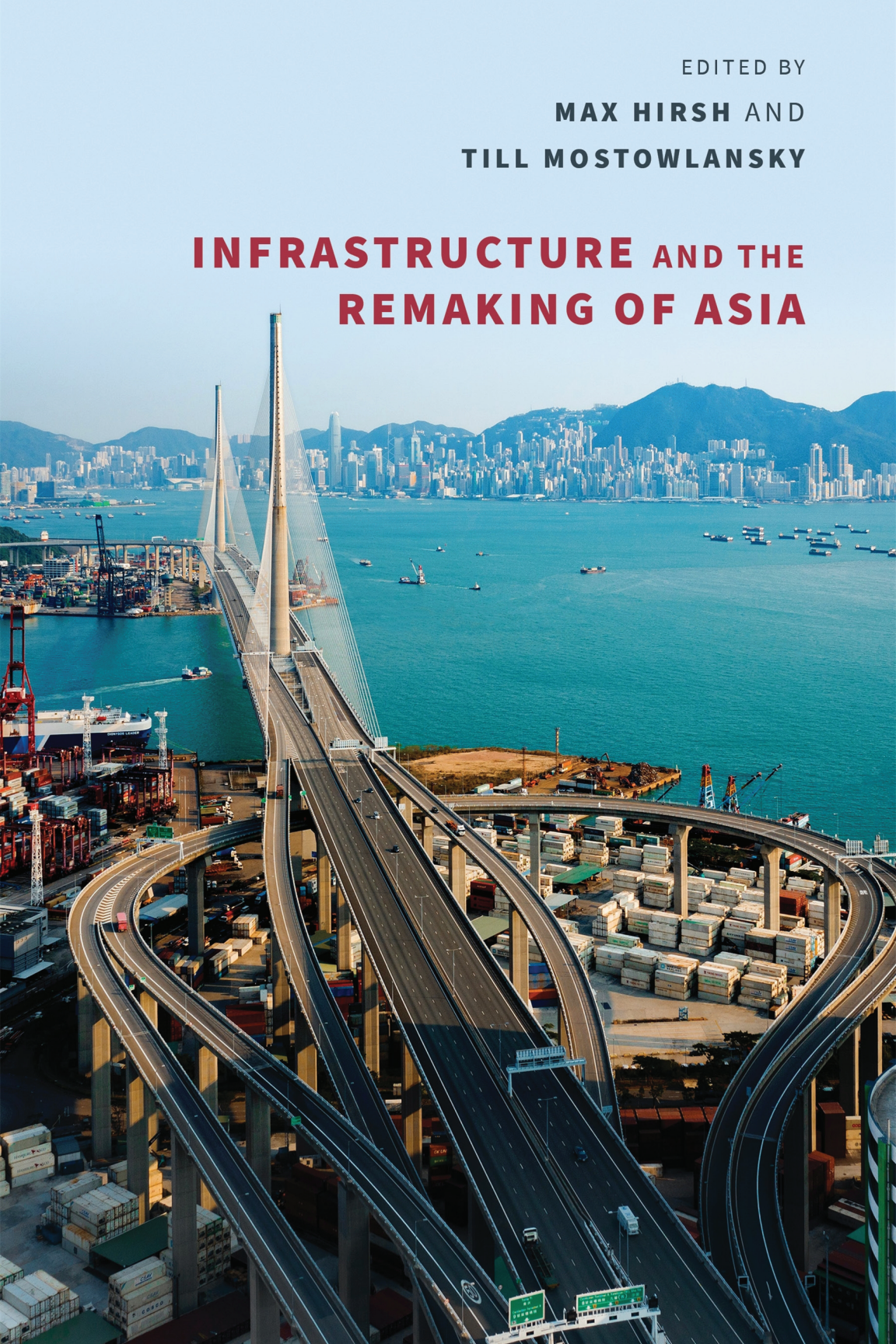
EDITED BY

MAX HIRSH AND

TILL MOSTOWLANSKY

INFRASTRUCTURE AND THE REMAKING OF ASIA



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Edited by
Max Hirsh and Till Mostowlansky

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Cover photo: Suspension bridge with traffic junction in the coastal urban area of Hong Kong on a sunny day. Photo by Manson Yim. Courtesy of Unsplash.com

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Acknowledgments

This book emerged from a series of workshops at the Institute of the Humanities and Social Sciences at the University of Hong Kong and the Center for Asian Studies at the University of Colorado Boulder. The authors developed their chapters through an innovative writing process that combined intensive editing sessions with site visits to the types of infrastructure projects—airports, high-speed rail stations, container ports—that the book critically examines. Through this collective effort, the individual chapters became tightly interwoven, both conceptually and stylistically.

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We dedicate this book to our spouses, son, and goddaughter. They kept us sane—and on our toes—during a very strange moment in history. Thank you, *danke,* and *do ze saai* Brook, Michael, Massey, and Lux.

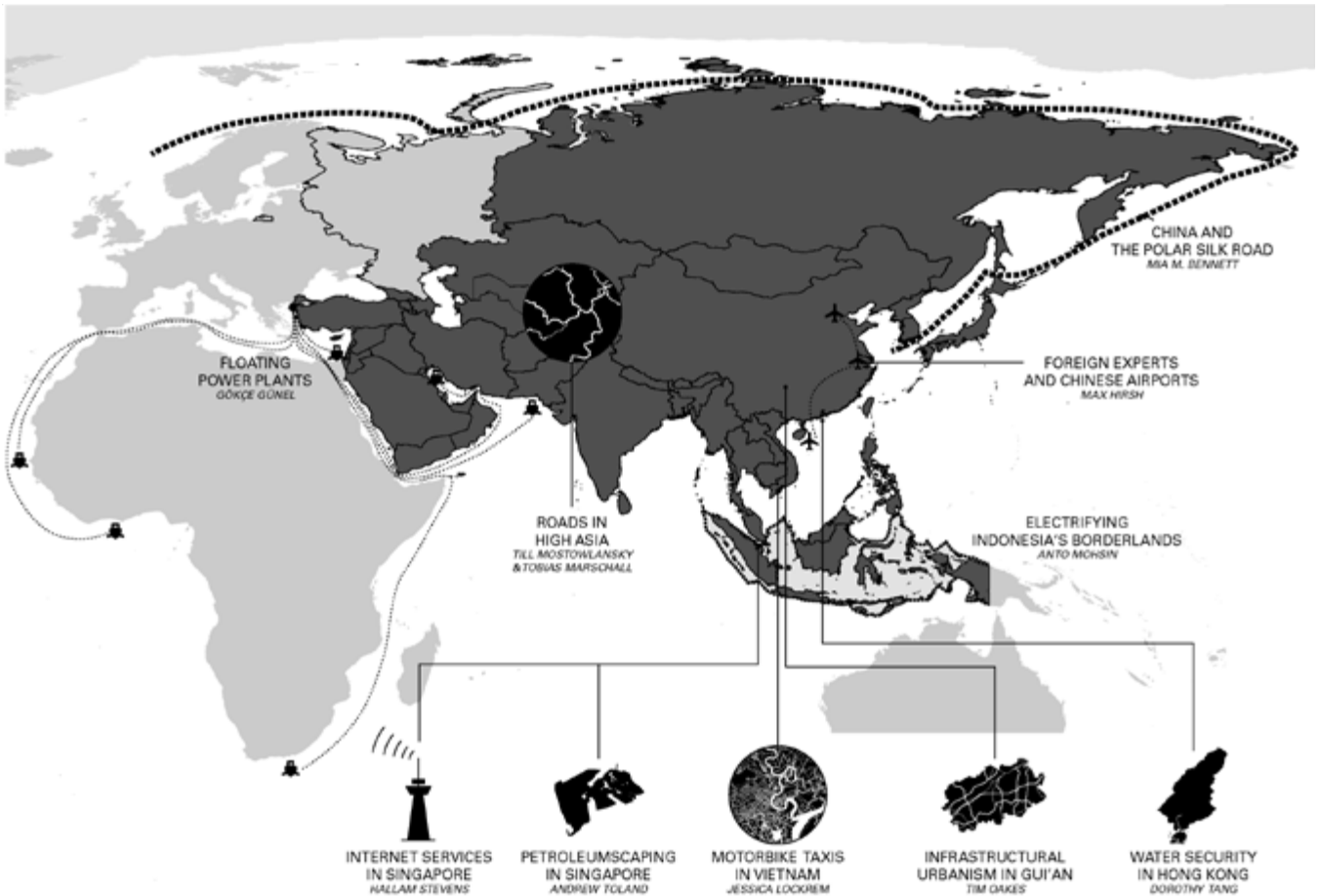

Figure 0.1. Infrastructure and the remaking of Asia. (Map by Dorothy Tang. Made with Natural Earth and Open Street Map data.)

INFRASTRUCTURE AND THE REMAKING OF ASIA

Introduction

TILL MOSTOWLANSKY AND MAX HIRSH

Since the end of the twentieth century, the development of infrastructure has undergone a seismic shift from West to East. Once concentrated heavily in Europe and North America, global infrastructure production today is focused squarely on Asia. Countless statistics testify to that geographic pivot, and to the resulting social and financial realignments. In 1995, for example, road investment in Germany—home of the autobahn—was triple that in China. Twenty years later, China outspent Germany by a factor of thirty-five. While German road budgets saw only marginal growth during that time, Chinese budgets ballooned by more than 12,000 percent (OECD n.d.). Similar patterns can be detected in other domains of infrastructure. Until the 1990s, for example, North America was the world's largest aviation market, hosting one-third of all global air traffic. Asia's contribution—7 percent of the total—was small by comparison. In the quarter-century that followed, Asia quintupled its share, overtook North America as the top source of air travelers, and built thirteen of the world's twenty busiest airports, most of them from scratch.[1]

The media frequently cite these kinds of figures in order to contrast the rise of Asia (especially China) with the perceived decline of Western societies. In this book, we seek to go beyond the statistical and the sensational, and to investigate the deeper implications of infrastructure's pivot from West to East. The book offers a new understanding of how geopolitical ambition, social change, and technological innovation converge and cross-fertilize one another through infrastructure projects in Asia. Drawing on fine-grained analyses of transportation, energy, resource extraction, and telecommunication systems, the book transcends two conceptual approaches that have long dominated the study of infrastructure: one emphasizing invisible power relations, and the other focusing on spectacular political symbols. By contrast, we focus on infrastructure's scale, a concept that opens up new ways of understanding how infrastructure is planned, produced, implemented, and used. To do this, we investigate infrastructure both from above (as seen from the perspective of experts and decision-makers) and from below (as perceived and experienced by middlemen, laborers, and everyday users). Analyzing

infrastructure through the lens of scale allows for more nuanced interpretations of its social, spatial, and political dimensions. And doing so powerfully illustrates the multifaceted connections between infrastructure and three global paradigm shifts: climate change, digitalization, and China's emergence as a superpower.

We have put together a collection of essays from scholars who are recognized as leading experts on infrastructure across six academic disciplines: anthropology, geography, history, science and technology studies, landscape architecture, and urban planning. The book is conceived as an act of interdisciplinary translation: linking up related—yet thus far disconnected—scholarship on infrastructure across a variety of fields, and making that research accessible to an audience of practitioners.

In recent years, a number of scholars have reviewed the state of infrastructure studies within the confines of their own disciplines.[2] Our book builds on that work by extending the conversation across disciplinary boundaries and by narrowing the geographic focus to Asia. Synthetic and selective rather than comprehensive in scope, the book draws upon the expertise of individual scholars in order to identify key intellectual concerns, concepts, and conclusions emerging out of these various fields. The book thus addresses multiple audiences working in, and on, all regions of Asia. Combining ethnographic and archival approaches from the social sciences with mapping techniques native to the design professions, the book establishes a dialogue between scholarly approaches to infrastructure and the more operational perspective of the professionals responsible for its planning, design, and governance. This multidisciplinary research method is uniquely positioned to shed light on the mindset and motivation of those practitioners, while also attending to the materiality and embodied agency of the infrastructures that they create. We apply this blended approach to ten case studies from China, Central and Southeast Asia, the Arctic, and the Middle East. The chapters that follow thus introduce new empirical strategies and conceptual lines of inquiry into the study of infrastructure's scales within an Asian context.

Infrastructure and Asia

Infrastructure is commonly understood as the backbone of national development, regional growth, and industrial modernization. It embodies technical innovations that are designed to move people, goods, and information, and it acts as a vehicle for paradigmatic shifts in the social and spatial organization of cities, nations, and regions. Infrastructure also serves a didactic purpose, both as a training ground for skilled and unskilled workers, and as a showcase for modern modes of geographic displacement. In that sense, the introduction of novel technologies via

infrastructural networks facilitates new kinds of knowledge transfers, the formation of distinct cultures of expertise, and the development of new kinds of people trained to use and consume innovative technologies.

One of the enduring challenges in writing about infrastructure is the slippery nature of the term, or what the historian Rosalind Williams (1990) has referred to as its promiscuity (see also Carse 2016). Nonetheless, infrastructure's denotational malleability can account for its enduring appeal. At various times over the past century, the term "infrastructure" has been applied both to tangible development projects, such as hydroelectric dams, seaports, and suspension bridges, and to intangible support systems of education, social welfare, and governance (Rankin 2009; Simone 2004). Scholars have conceptualized these manifold manifestations through a variety of epistemological frameworks. For example, critical Marxist scholars have theorized capitalism by employing Marx's distinction between infrastructure (the social and technical forces that make up a society's economic base) and superstructure (the laws, ideologies, and aesthetics that are determined by that infrastructure). Meanwhile, the fields of development studies and urban studies have deployed infrastructure as a lens to use in the critical analysis of public space and material politics (Appel, Anand, and Gupta 2018; Soja 1989), and science and technology studies have emphasized the expert knowledge underlying infrastructural innovation, the social life of technical systems, and the politics of engineering.[3]

Infrastructure's variability and flexibility thus pose a challenge for a book with multidisciplinary ambitions. In response, we have developed a working definition of infrastructure that connects our authors' various objects of inquiry and is coherent with the common usage of the term in the professional worlds of planners, policy-makers, and engineers. We define infrastructure as the physical, material backbone of transportation, energy use, resource extraction, and telecommunication. This definition has achieved broad consensus across a variety of academic disciplines, and it has endured across time, cultural contexts, and intellectual trends. At the same time, by merging conceptual approaches from the fields of anthropology, urban planning, and science and technology studies, we locate infrastructure at the intersection of its social, material, and regulatory components—none of which could effectively operate without the others.

The early twenty-first century has seen the production of several excellent studies of infrastructure in Asia, grounded in rigorous, site-based research.[4] Most of them, however, have been conducted within the boundaries of a single nation-state. The promotion of China's Belt and Road Initiative has also led to a flurry of cross-regional surveys on China's infrastructural forays into Asia, Africa, and further afield (Lim et al. 2016; Sidaway and Woon 2017). While these studies provide

a helpful overview of China's broad geopolitical ambitions, they often lack the depth of insight that on-site fieldwork can provide. By bringing together the expertise of twelve authors in a single volume, this book uses the rigorous, site-based, empirical research of individual experts as the basis for conceptual connections across regions of Asia that rarely invite comparison, such as Southeast Asia and the Middle East. By foregrounding circulations, connectivities, and mobility—which are, after all, what infrastructure is designed to abet—we are able to examine cross-cultural and cross-regional transfers of infrastructural technologies, knowledge, and practices throughout Asia (Duara 2010; Tagliacozzo, Siu, and Perdue 2015).

Specifically, *Infrastructure and the Remaking of Asia* demonstrates the multiple pathways through which infrastructural expertise is transferred from place to place, and interrogates how infrastructural ideals are subsequently appropriated, modified, and hybridized with vernacular and local practices. In so doing, the book enhances the understanding of how the mobility of experts, building materials, technical plans, and infrastructural models has effected broader changes in the making and remaking of Asia. This framework also allows us to interrogate the social dimensions of infrastructural development by situating the role of experts and expert knowledge in relation to infrastructure's modification by end users. How are infrastructure networks envisioned by those who design and finance them, and to what extent are those visions shared by the people who build, operate, and use them? What happens when infrastructural techniques and technologies are transferred from one social and geographic context to another? What is the nature of the interactions among governmental agencies, transnational funding bodies, and design firms, and what types of infrastructural strategies do those collaborations either create or foreclose? And how do people experience, engage with, and make use of infrastructure in mundane settings?

Attention to infrastructure is particularly crucial in the case of Asia, for reasons both historical and contemporary. In the nineteenth and twentieth centuries, European powers devoted considerable financial, intellectual, and human resources to the construction of infrastructure in Asian entrepôts and colonial hinterlands, building railway and telegraph lines, dredging deepwater ports and erecting reservoirs, and installing basic sanitation systems throughout the region. As elsewhere, in Asia these projects were positioned both as part of a broader civilizing mission and as an effort to bind colonies' populations and natural resources more closely to the mother country—geographically, economically, and ideologically (Tilley 2011). In the twentieth century, these European powers were joined by Japan—which, under the guise of "co-prosperity," transformed vast swaths of East and Southeast Asia into laboratories of infrastructural modernity in the

domains of transportation, resource extraction, and water management, among others (Seow 2014). That approach persisted after World War II in Japan's export of infrastructural technologies (chiefly in the form of hydroelectric, aviation, and skyscraper projects) through technical assistance and development aid programs (Moore 2014).

These projects functioned both as indispensable diplomatic tools and as fundamental components of economic policy, opening up markets and spreading technical norms and standards abroad. That strategy was instrumental in the spatial and economic transformation of cities like Hong Kong, Singapore, and Taipei, all of which adopted Japanese approaches to infrastructure-led urban and regional development. Elevated skywalks, high-rise apartment blocks, and railway-oriented, air-conditioned retail environments quickly became essential signifiers of what it meant, in the East Asian context, to be modern. Those ideas subsequently filtered into post-Mao China through the transfer of capital and infrastructural expertise originating in Hong Kong, Singapore, and Taiwan.

Attending to the broader historical role that infrastructure has played in Asia's development is essential to understanding the twenty-first-century fixation with infrastructure-driven models of socioeconomic development and infrastructure-led diplomatic overtures such as China's Belt and Road Initiative. After the end of the Cold War, investments in infrastructure were heavily and disproportionately concentrated in Asia. Between 1992 and 2013, China devoted nearly one-tenth of its annual gross domestic product to building infrastructure, which accounted for one-third of all infrastructure investments worldwide (OECD n.d.). From the perspective of Asia's political leaders and policy-makers, infrastructure occupies an almost sacred position as the material precondition for future growth; as an emblem of modernization, efficiency, and progress designed to win over domestic publics and attract foreign direct investment; and as a safe bet for equity funds and institutional investors looking for stable long-term returns. Amid that enthusiasm, it is relatively rare for the near-term utility of individual projects to be called into question.

In that future-oriented context, infrastructure projects are often prized more for their symbolic foreshadowing of a better tomorrow than for their present-use value (Hirsh 2016). They function almost as objects of piety, combining a heady dose of faith and fantasy: faith in the legitimacy of existing political and economic structures, and fantasy about a future when technologically advanced infrastructures can compensate for broader deficits in governance and social development.

It is through infrastructure's symbolic value and its use as a political tool that infrastructure has been analyzed across a variety of academic disciplines—and not without reason. Particularly in developing countries, infrastructure is an easily

decipherable index of technical progress and economic development, as well as of effective stewardship by political elites (Khan 2006). It also operates as a shorthand to explain complex geopolitical relationships, as governments deploy transportation, energy, telecommunication, and resource extraction projects both as physical manifestations of bilateral ties and as confirmation of their socioeconomic benefit. As the architectural historian Cole Roskam (2015) has noted, Maoist cadres positioned infrastructure projects as material demonstrations of the People's Republic of China's solidarity with developing nations in the Third World, in contrast to the exploitative practices of the capitalist West. Echoes of that infrastructural diplomacy reverberate outward from Asia in the present day, as countries like China, Japan, South Korea, and Turkey export infrastructural know-how abroad. State-led policy initiatives—including both China's Belt and Road Initiative and its intellectual progenitor, the Greater Mekong Subregion—rely on infrastructure to signal intensified economic ties and to create novel geopolitical alliances throughout Africa, Asia, the Middle East, and the former Soviet sphere.

Infrastructure's political symbolism, and particularly its capacity to instantiate a variety of ideological concepts, especially of the "neo-" variety (neo-liberalism, neo-colonialism, and perhaps nowadays neo-Maoism), is an understandably tantalizing area of inquiry for academic researchers. In this volume, however, we would like to propose a more nuanced approach to the analysis of infrastructure. To begin, let us turn to the word's etymology. The historians Dirk van Laak and William Rankin trace the term's origin to the domain of engineering. In the latter half of the nineteenth century, French engineers used the term to describe the literal substrate upon which France's railway network was being built: that is, man-made structures and physical alterations of the landscape such as embankments, bridges, and level crossings. That infrastructure, in turn, supported a so-called superstructure of rails, electrical lines, and train stations (van Laak 2004; Rankin 2009).[5] By the early twentieth century, the word "infrastructure" had transcended its narrowly technocratic roots and developed a broader conceptual meaning. The 1925 edition of André Lalande's *Vocabulaire technique et critique de la philosophie* defined it as an "underlying structure, generally hidden or unnoticed, that supports something visible and apparent." Additionally, infrastructure denoted "unconscious behavior that enables or determines a conscious act," as well as "social structures, and especially economic phenomena, that are the unconscious origin of certain ideas" (Lalande 1925, 73, translation by the authors).

In this sense, infrastructure does not embody political ambitions and economic goals; rather, it is the unacknowledged originator of those ideas. This definition is the antithesis of the political symbolism argument that is pervasive in

academic research on infrastructure. In this volume, we ask: What can we learn by reversing that causality? In other words, rather than demonstrating how infrastructure is the physical outcome of specific political agendas and economic ideologies, what if we begin with the idea that infrastructure has an agency and an autonomy of its own that can directly influence political outcomes, social attitudes, cultural practices, and ideological positions (Blau 1999)? As any infrastructure professional will privately acknowledge, once a project is under way, things rarely go according to plan. The reality of infrastructure development is messy, unpredictable, and multidirectional. Like a book or a work of art, over time an infrastructure project such as an airport, road, or electricity grid takes on a life of its own, one that is independent of its creators' intents (Harvey, Jensen, and Morita 2016, 10).

The chapters in this book investigate how infrastructures produce new urban forms, new ways of living, and new modes of thinking that diverge significantly from the outcomes that were intended when they were conceptualized (Hirsh and Tang 2020). We acknowledge the kaleidoscopic variety of actors, social processes, and spatial formations that are involved in infrastructure planning, financing, design, operation, and use. The prism of scale serves to connect these different dimensions, layers, and hierarchies as they interact with materiality, territory, and networks across Asia.

The Scale of This Book

In the humanities and social sciences, the concept of scale is often employed to explain how humans rely on levels, layers, hierarchies, and sizes to organize and make sense of the world around them.[6] Scales are thereby conceived of as "areal 'space envelopes,' as networked, as material social products, as mental fictions, [and] as merely logical divisions of the Earth's surface" (Herod 2011, 250). In this book, we focus on two specific aspects of scale. First, we examine how infrastructure serves as a tool to transform space, and how those transformations produce new hierarchies, levels of interaction, and imaginations of the world. Second, we analyze the social implications of infrastructure, investigating its impact on both the lives of individual people and on society as a whole. The chapters create a dialogue between big displays of infrastructure, loaded with political symbolism and designed for mass consumption, and subtler, more mundane perspectives on it by individuals on the ground. This entails a thorough investigation into the multiple locations and actors involved in infrastructure's planning, production, implementation, and use, and it requires an understanding of the specific local contexts

in which infrastructure is produced. With that in mind, we have organized the book's chapters around three central themes—materiality, territory, and networks—that illuminate infrastructure's social and spatial scales.

Part I: Materiality

Discussions of scale have historically centered on either the material or the mental constitution of the world.[7] While materiality and the social construction of ideas have both crucially informed how scholars think about scales of infrastructure, the implicit binaries between space and society and between matter and ideas persist (Collinge 2005). The book's first section offers three solutions to overcoming these binaries.

Mia M. Bennett's chapter examines how China has become a geological force in the Arctic. Since the beginning of the twenty-first century, China has been the world's largest consumer of commodities and the largest emitter of greenhouse gases. China has also expanded its infrastructure networks in the Arctic in an effort to advance its political claims as a near-Arctic state. Identifying China's infrastructure investments as a key driver of Arctic climate change, Bennett argues that China has effectively "become a geological agent, or an actor capable of substantially altering Earth's physical structure and substance." She offers a sophisticated insight into how economic policies determined at the national level—in this case, capitalism with Chinese characteristics—effect environmental and ecological transformations on a global scale.

Scaling down from planetary concerns to those of a city-state, Andrew Toland's chapter on "petroleumscaping" investigates the material, economic, and cultural motivations that led to the creation of Singapore's Jurong Rock Caverns—man-made subterranean installations that have helped Singapore become one of the world's largest oil-refining and oil-trading hubs. Singapore's limited land supply impelled policy-makers to conceptualize the country's subsurface as a new frontier for infrastructural development. That strategy is indelibly tied to Singapore's broad ambitions to produce both a new political economy and a new national identity. Investigating how technical expertise and cultural attitudes coalesced around the city-state's unique landscape and geological conditions, Toland uses petroleumscaping to illuminate the remaking of Singapore—from a city-state forever anxious about its lack of land and natural resources, to a country in which both land and resources can be entirely artificially constructed. He concludes that this obsession with transcending the limits of Singapore's land scarcity is intertwined with decision-makers' desire to play an outsized economic role on the global scale.

Bennett's discussion of the geopolitics of climate change and Toland's investigation of coastal energy experiments resurface as key themes in the final chapter of the book's section on materiality, in which Gökçe Günel charts the rise of Turkish powerships (repurposed vessels that serve as mobile power generators) as floating, provisional modes of energy infrastructure. These offshore power plants are attached to national grids and, using petroleum and natural gas, supply cheap supplementary electricity. By enabling countries to overcome chronic power shortages, the powerships operate both as vessels for short-term economic growth and as tools for long-term bilateral diplomacy, as Turkey (much like China in the Arctic) seeks to assert itself across a vastly enlarged, loosely defined Asian domain (Tagliacozzo, Siu, and Perdue 2015). At the same time, Günel reveals how a shift in temporal scale (from permanent to temporary) generates a scalar shift in spatial relations. For the recipient countries, these short-term energy fixes quickly evolve into long-term dependence on distant resource providers.

Part II: Territory

Studies that analyze how political structures are established and how political power is divided among competing institutions often discuss the intersection of scale and territory.[8] As Peter Sahlins (1989, 8) points out in his study of the emergence of national boundaries in France and Spain, this process involves a dialectic between "local and national interests" that are copresent in the production of territory. This book's second section elaborates on that discussion by investigating infrastructure's territorial scale across three different domains: electricity, water supply, and telecommunication.

Anto Mohsin's chapter examines the ongoing process of electrification in Indonesia in the twenty-first century, highlighting the entanglement of electrification endeavors with assertions of territorial integrity. Electrical infrastructure in Indonesia was first developed in urban areas, with a slow and still ongoing spread to the countryside. This center bias has persisted because of the government's priorities and the country's archipelagic geography. In analyzing this slow spread, Mohsin shows that the state perceives the electrical grid not only as central to Indonesian territory, but also as the blood in the circulatory system of modernity that is supposed to reach the country's most remote pockets. However, Mohsin demonstrates that many people in Indonesia's border regions remain electricity-poor and dependent on local or cross-border solutions, and he emphasizes the need for analyses of critical infrastructure to go beyond the scale of the nation-state and to take contested borderlands into consideration. Indonesia's electrification thus exemplifies the centrality of infrastructure's role in territorial scales.

The question of contested territoriality is similarly crucial to the following chapter, in which Dorothy Tang turns to Hong Kong's reservoirs and aqueducts to illustrate how hydrological engineering has been intricately linked to broader concerns about colonialism, geopolitics, and territorial integrity throughout the past two centuries. Focusing on Hong Kong's chronic dependence on imports to secure an adequate supply of water, Tang examines the coproduction of cross-border water management systems alongside discourses of self-determination as the British colony was transformed into a special administrative region of China. The chapter studies landscape transformations as well as territorial rescaling produced by Hong Kong's hydrological infrastructure. Tang argues that these transformations reflect the geopolitical anxieties of successive regimes, as well as the trust (or distrust) of those regimes on the part of their subjects.

In the final chapter of the book's second section, Hallam Stevens discusses Teleview, a unique videotex system that operated in Singapore in the 1980s and 1990s. Stevens links Teleview to the themes of the nation-state, territoriality, and state-citizen relations that run through this part of the book, and shows how infrastructure has played a critical role in the Singapore story. Infrastructure projects such as Teleview played a part not only in transforming the island nation from Third World to First, but also in maintaining the government's political legitimacy. By examining the state's vision for Teleview and how the system was received by its users, Stevens uses emerging digital technologies as a prism to explore what kind of society Singaporean leaders hope to build. While the global internet has been a supposedly market-driven endeavor (especially from an American perspective), Singapore's approach has remained different, and policy-makers in Singapore are still fundamentally concerned about the kinds of citizens that networked online interaction produces. The historical example of Teleview highlights the continuity of Singapore's paternalistic approach to infrastructure and how people have pushed back against as well as accommodated those ideals.

Part III: Networks

Scholars and practitioners have long used the structuring principle of networks to explore connectivity between different parts of society, between the physical and the digital, and between human and nonhuman actors (Castells 1996). The historian Antoine Picon (2018), for example, demonstrates how urban planners use the concept of the network to assert the interdependence of various kinds of infrastructure (roads, canals, and fiber-optic cables) and to emphasize the dangers inherent in planning any one of these infrastructures in isolation. Similarly,

social scientists turn to networks in order to highlight the interdependence between infrastructures' technical dimensions and the sociopolitical contexts in which they are conceived.[9] They have rethought, and at times transcended, some of the most basic scales deployed in research on cities and regions: micro versus macro, proximate versus distant, simultaneous versus sequential, mobile versus static (Dalakoglou 2017). In the third section of this volume, we investigate infrastructures that operate at the scale of networks. While they are often brought to life by top-down decision-making processes, these networked infrastructures are not necessarily hierarchically ordered and maintained. Expanding horizontally, they are both produced and reproduced via mutually reinforcing networks of data, expertise, and sociality.

The chapter by Tim Oakes studies the role of big data in infrastructure-led urban development projects in China, and the emergence of a novel type of infrastructural urbanism in which wide-ranging aspirations for digital, ecological, and intellectual innovation converge and, ultimately, negate each other. Part of a nationwide network of experimental urban design projects, Gui'an New Area in Guizhou Province is a showcase of leading-edge smart-city, eco-city, and sponge city urban planning techniques and technologies. In Gui'an, planners, developers, and local officials seek to implement government-mandated innovation indicators. The area is promoted as an exceptional space of algorithmic governance, enabled by big data infrastructures and physicalized by a regional transportation grid that fundamentally reorders the conventional scale of city planning. From this perspective, Oakes writes, Gui'an New Area functions as an emerging node in a much broader network of surveillance and securitization.

The next chapter shifts our focus westward: Till Mostowlansky and Tobias Marschall explore routes in the borderlands of Afghanistan, China, Pakistan, and Tajikistan. In this region of High Asia, roads have long served as vehicles for ambitious modernization projects, resulting in the construction of the Soviet Pamir Highway in the 1930s and the Pakistani-Chinese Karakoram Highway in the 1960s. At present, the development of Afghanistan's road to China parallels the development of these predecessors, but it also follows and intersects with existing and emerging routes in the region. Against this backdrop, Mostowlansky and Marschall describe a network of pathways and roads—frequented by animals, cars, and pedestrians—that connect people and institutions across High Asia. These pathways and roads are interlinked with, but also operate in parallel to, the abovementioned highway projects. While state actors perceive these large construction projects as key drivers of modernization and cross-border trade, they do not in fact dominate everyday social and economic life. Instead, Mostowlansky

and Marschall argue, the highway projects coexist with a regional network of routes enabling the movement of goods, people, and information by less visible means.

Jessica Lockrem's chapter on motorbike taxi drivers and ride-share apps in Vietnam's Ho Chi Minh City elaborates on the intersection of physical and social networks in transportation infrastructure by attending to a digital network as well. Playing an integral role in the urban transportation system, motorbike taxi drivers highlight the importance of people as infrastructure in keeping the city moving. However, as Lockrem illustrates, these drivers provide more than just transportation for Ho Chi Minh City's residents. By spending many hours in public space, they also function as critical infrastructures of security, order, and information. That traditional role has been increasingly challenged by the emergence in Vietnam of ride-share apps. The chapter investigates how digital technologies change the way drivers inhabit urban space, and how these technologies effect changes in the social and spatial practices of their users. While the state has attempted for decades to modernize Vietnamese streets by clearing sidewalks of activities (with varying degrees of success), ride-share technology is unintentionally aiding these attempts. Lockrem charts how apps have transformed Ho Chi Minh City's urban transportation networks and affected the city's taxi drivers, streetscapes, and communities.

The final chapter of this section of the book shifts from the road to the air, and from urban transportation networks to global networks of civil aviation. Studying the development of China's airport infrastructure since the 1980s, Max Hirsh investigates the role of foreign technical experts, illuminating the multidirectional processes by which infrastructural knowledge was imported into China from Europe, Japan, and North America during the post-Mao period of Reform and Opening Up. He focuses on a series of training and technical aid programs that were organized by overseas universities and airport planning firms. Analyzing the transnational origins of China's infrastructural expertise, Hirsh argues, allows us to better understand how and why the so-called China Model of infrastructure-led urban development was subsequently exported across Asia, Africa, and the former Soviet sphere.

Afterword

In the afterword, Edward Simpson reflects on the future of infrastructure as it relates to broader multilateral processes of collaboration and disengagement. Meditating on the book as a whole, he notes that each of the volume's chapters sheds light on infrastructure's complexity and messiness on the one hand, as well as on its totalizing logic and aspirational objectives on the other. This juxtaposition,

Simpson observes, reveals an enduring ambition to modernize Asia through infrastructure, despite the growing challenges posed by climate change. For Simpson, this raises the crucial question of how to establish resource equality and ecological responsibility under worsening environmental conditions, and it leads him to conclude that Western discourses on sustainability—which propose a radical reduction in energy consumption and mobility as the solution for an uncertain environmental future—remain fundamentally disconnected from infrastructural realities in much of Asia.

Notes

1. See, e.g., IATA 1992, 2019.
2. See, e.g., Edwards 2003; Harvey, Jensen, and Morita 2016; van Laak 2004; Larkin 2013.
3. See Bijker, Hughes, and Pinch 1987; Biggs 2008; Dinçkal 2008; Edwards 2003; Hughes 1983; Reuss 2008.
4. See, e.g., Anand 2017; Barry 2013; Mizuno, Moore, and DeMoia 2018; Seow 2014.
5. As van Laak (2004, 288) notes, the parallels to contemporary Marxist concepts of base and superstructure, which were translated into French as "*infrastructure et superstructure*" in the early 1860s, are quite evident.
6. See Berg 2004; Brenner 2001; Brown 2000; Castells 1996; Comaroff and Comaroff 2003; Latour 1996; Mahon 2006; Tsing 2000.
7. This is evident, for instance, in the distinction between Marx and Kant.
8. See, e.g., Herb and Kaplan 1999.
9. See Bijker, Hughes, and Pinch 1987; Hughes 1983; Latour 2005.

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PART I

Materiality

CHAPTER ONE

Rise of the Sinocene?

China as a Geological Agent

MIA M. BENNETT

In 2018, China released its Arctic Policy, an English-language white paper asserting that the country is a "near-Arctic state" (*jin beiji guojia* 近北极国家) (State Council Information Office of the People's Republic of China 2018). Western political officials and media regard this self-declared status with skepticism. At the May 2019 ministerial meeting in Rovaniemi, Finland, of the Arctic Council (the region's preeminent intergovernmental organization), US Secretary of State Michael Pompeo declared, "There are only Arctic states and non-Arctic states. No third category exists, and claiming otherwise entitles China to exactly nothing" (Pompeo 2019). While any supposed "entitlements" that China—which is approximately nine hundred miles from the Arctic Circle—might have to the region are thus disputed, the sheer scale of the country's economic activities and its extending infrastructural networks are having significant impacts on the Arctic environment. The direct connection between China's economic activities and their global environmental footprint suggests that the country has become a geological agent, or an actor capable of substantially altering Earth's physical structure and substance.[1]

While climate change has spurred natural and social scientists to recognize humans' ability to indelibly alter the planet, more precise examinations of geological agency at scales more politically actionable than that of the entirety of humanity are lacking (Clark and Yusoff 2017; Yusoff 2013). The increasing evidence for all the ways in which humans are affecting the climate makes it easy to attribute responsibility to the species as a collective rather than "any individual person, policy, politician, community, or nation" (Rudiak-Gould 2015, 51). Yet specific phenomena can be connected to individual countries and their economic activities. Identifying these links is done not to point fingers, but rather to determine leverage points within complex systems where interventions can be made (Meadows 1999; Abson et al. 2017).

Since its policies of Reform and Opening Up began in 1978, China has driven much of the world's urbanization, industrialization, and development—all of which

are carbon-intensive processes that impact the Arctic. The country's disproportionate role in driving Arctic climate change can be attributed to its massive scale. Between 1980 and 2010, China's level of urbanization increased nearly 30 percent, with its cities gaining an additional 478 million residents (Farrell and Westlund 2018). To support its urban, industrial, and infrastructural transformation, China has become the world's largest consumer of commodities—both quotidian, like oil and iron ore (Coates and Luu 2012), and obscure, such as molybdenum (Outteridge et al. 2019). The enormity of this resource consumption (especially of fossil fuels) led China to surpass the United States as the world's largest emitter of greenhouse gases in 2006 (Vidal and Adam 2007).

China's rapid industrialization combined with its greenhouse gas emissions have endowed the country with an "unprecedented ability to change the socioeconomic landscape, produced great wealth, and led to some catastrophic environmental change" (John Moore et al. 2016, 588), both within and outside its borders. Emissions from China alter Arctic atmospheric circulation patterns, which in turn affect East Asian weather patterns. China's status as the world's largest emitter of greenhouse gases thus makes it critical that we understand how activities originating within the country's borders are affecting climate change, both in and beyond the Arctic.

Examining China's geological agency is scientifically and politically timely for two reasons. First, since the early 2000s, scholars have increasingly recognized that the planet has entered the Anthropocene: the geological epoch in which humans have become the single largest geological force acting on the planet, making it warmer, wetter, stormier, and less biodiverse.[2] Natural and human forces have become so closely interlinked that "the fate of one determines the fate of the other" (Zalasiewicz et al. 2010, 2231). Even if the formal designation of a new geological epoch remains debated, there is a growing consensus on humankind's ability to drive not just environmental change but also geological change.

Second, the Anthropocene is not only a scientific concept: it is also a moral and political one (Ellis and Trachtenberg 2014). Acknowledging that a large proportion of global environmental change is anthropogenic represents an important ethical shift regarding humans' understanding of their place in the world (Chakrabarty 2009). However, to affect policy and change behavior, responsibility must be attributed at politically actionable scales. Social scientists have called for breaking down the "anthro" in the Anthropocene in order to identify the spatially uneven drivers and power relations of global environmental change.[3] From a similar standpoint, Kathryn Yusoff (2013, 782) suggests complicating the "unifying claims of global geologic agency" attributed to humankind—which this chapter, by examining China's geological agency, seeks to do. Within this framing, it becomes possible to

conceive of the Sinocene, in which regional and even planetary environmental shifts can be attributed to activities occurring within China.

The fact that economic and environmental policies are still largely decided at the national level makes it logical to assign responsibility for environmental change to specific countries, whether historically or in the present day (Neumayer 2000). By highlighting the case of China, I aim to demonstrate how one country's economic activities can disrupt distant ecosystems. I wish to underscore that this research is done not to blame China for the Arctic's rapidly destabilizing environment, but rather to emphasize how the scale of China's economic activities affords it geological agency. While this capacity has negative environmental consequences, it also makes it possible for China to identify and implement unilateral, at-source solutions to climate change, alongside multilateral ones in which the government's involvement is key.

Interest in the Anthropocene has given rise to the subfield of political geology, which considers the relationship between politics and geological forces like eroding shorelines and erupting volcanoes (Bobbette and Donovan 2019). By entering the Anthropocene, society has arguably left the era of geopolitics and entered the era of geological politics (Clark 2013; Dalby 2015). If power relations in the previous era involved control over terrain, they now involve control over the entire planet, from its strata to the layers of the atmosphere. In the twentieth century, geopolitical power depended on the ability to project control over terrain, turning the planet's surface into a political technology known simply as "territory" (Elden 2010). States could accumulate territorial control by exercising military power over land, sea, or air or through "infrastructural power" and the ability to penetrate a distant polity's peripheries (Mann 1984, 185).

Yet in the era of geological politics, control over terrain has taken on a more vertical dimension, penetrating below and above Earth's surface (Elden 2013; Dalby 2013). Volumetric geology rather than flat territory is the new target of political manipulation and control, especially at "elemental interfaces" (Sammler 2019, 14). The expansion in the scale and extent of Anthropocene geopolitics is particularly apparent in the environmentally dynamic Arctic, whose rate of warming is now three times that of the global average (AMAP 2021)—a phenomenon called "Arctic amplification" (Dai et al. 2019). Melting ice sheets, thawing permafrost, and newly accessible fossil fuels are both causes and effects of a more volumetric regional geopolitics. National governments are sending submarines to the seafloor, icebreakers across the frozen surface, and satellites into space to accumulate more knowledge about the rapidly changing Arctic.

While significant attention has been paid to China's activities in the Arctic, fewer links have been drawn between the country's domestic activities and changes

to the northern cryosphere. As China has urbanized, modernized, and industrialized, it has sought to perpetuate these economic activities and extend them beyond its borders. The country's participation in the development of climate-impacted regions such as the Arctic is facilitated materially, by global geophysical shifts set in motion within China, and discursively, by rhetoric that legitimizes the country's interventions while underplaying its responsibility for climate change. Countries that industrialized at a relatively early stage, like the United Kingdom, Germany, and the United States, are of course responsible for the bulk of historical greenhouse gas emissions, a fact that has spurred calls to hold them accountable (Neumayer 2000). For over 15 years, however, China has been the world's largest emitter of greenhouse gases. Moreover, due to Asia's rapid development over the past three decades, the continent's greenhouse gas emissions bear more responsibility for Arctic climate change than those from any other region (Sand et al. 2016). The environmental and political consequences of Chinese geological agency merit analysis, especially as the Chinese government becomes a bigger player in global development and governance (Y. Wang 2019).

This chapter is structured as follows: First, I conceptualize geological agency, noting the direct and indirect ways in which it sets in motion large-scale changes to Earth's ecological and biogeochemical systems. Second, to sketch out the materiality of geological agency, I relate China's greenhouse gas and black carbon emissions to environmental and geophysical transformations in the Arctic. Here, I draw on secondary sources—namely, peer-reviewed scientific literature examining the relationship between emissions from Chinese industries and the circumpolar north. Third, I reflect upon how Chinese state discourse presents the country as a geological subject or victim rather than as a geological agent, in a manner that suggests that China's actions in the Arctic are precautionary and defensive rather than offensive. I also address how the Chinese industrial sectors responsible for driving Arctic climate change (specifically, steel manufacturing) are taking advantage of new opportunities arising in Arctic shipping routes and oil and gas development, particularly in Russia. I conclude by reflecting on the ultimate ephemerality of geological agency.

By attending to "the deep temporalities and elemental forcefulness of the earth" (Clark 2013, 2831) as well as to the forcefulness of political actors such as China, the chapter analyzes not only the distinctly geological nature of politics in the Anthropocene, but also the scales at which these elemental changes are manifesting. Climate change remains a problem whose solution will require collective action. Yet developing an accounting of which actors and activities are responsible for environmental alterations—especially in remote and sparsely populated environments like the Arctic, where the consequences of activities outside the region

are more extensive than of those from within—is a prerequisite for crafting precise, actionable policies. Regardless of whether states are non-Arctic or near-Arctic, their activities can still affect the circumpolar north. For that reason, geological agents, no matter how distant, must be considered in any reckoning of present and future conditions in the Arctic.

On Geological Agency

In the Anthropocene, geological agency can be traced to a narrower scale than the entirety of humanity, for certain actors bear more responsibility for environmental change than others. However, since contemporary critical social thought is arguably missing "a conceptual armature for dealing with the geologic agency of humankind" (Clark 2013, 2828), social scientists have yet to fully consider the geophysical implications of this uneven political culpability. The ongoing material and infrastructural turns within the social sciences suggest a renewed embrace of tactile topics rather than abstract representation, thought, and discourse (Anderson and Wylie 2009; Larkin 2013). Yet in fact, not only does much of this work ignore actual earthly matters and substances (Ingold 2007): it often fails to engage with research in earth sciences that can help explain the very changes to the planet's physical processes that undergird the Anthropocene. Examining these environmental dynamics through a political lens can more precisely identify the sources of geological agency, at a scale conducive to producing solutions to climate change.

So what exactly is geological agency? The term might first bring to mind geoengineering (the direct manipulation of Earth's ecosystem). The era of political geology inevitably presents new opportunities for the practice, which is the field "most directly and practically geared towards the prospect of transgressing thresholds in earth systems" (Clark 2013, 2829). For its part, China has become a geoengineering pioneer. Various technologies that the country's scientists are exploring include injecting aerosols into the stratosphere using a technique known as "stratospheric geoengineering" (Cao, Gao, and Zhao 2015), remediating air pollution and haze via "water spray geoengineering" (Yu 2014), and carbon sequestration. China's state-sponsored National Key Basic Research Program has established a coordinated team of scientists researching geoengineering, with their work notably focusing on China and the Arctic (Cao, Gao, and Zhao 2015).

Geoengineering, however, is not the only way in which geological agency can be exercised. Geological agency can also derive from indirect actions. Unintended geoengineering (the more or less accidental consequences of activities not meant to alter Earth's environment) is what is responsible for climate change. Humanity

never intended to warm the planet by burning trillions of barrels of oil. On a smaller scale, China did not intend to contribute to Arctic climate change through its pursuit of urbanization, industrialization, and modernization—yet these processes are melting sea ice thousands of miles away. The links between environmental changes in China and those in the Arctic are well documented by research in the earth sciences, which the next section examines in order to provide insights into the material and geophysical dimensions of geological agency.

China also wields its geological agency in a discursive manner by putting forward narratives of a country that is threatened by climate change and that at the same time is contributing to the region's economic development. Radical changes to the Arctic's land-, sea-, and icescapes are generating new opportunities in shipping, tourism, fishing, and oil and gas exploration, all of which interest China (Moe and Stokke 2019; Hsiung 2016). In 2017, China incorporated the Arctic into its formal plans for the Belt and Road Initiative, and in recent years has been partnering with Russia to develop the Polar Silk Road (Tillman, Jian, and Nielsson 2018). These joint plans envision expanding shipping activities along Russia's northern coast in the hopes of better connecting markets in Europe and Asia—or at least, of facilitating the export of northern resources to these destinations. These environmental and economic shifts also offer political opportunities for the development and governance of a region perceived as being in a state of emergency, requiring collective and increasingly external action (Dittmer et al. 2011). Ironically, then, geological agency afforded by national economic activities can produce inroads into regional and global environmental governance.

On the one hand, China has demonstrated global leadership in climate change initiatives. The country signed the Paris climate agreements in 2016. It is also working toward replacing coal with natural gas, and is aiming to reach peak greenhouse gas emissions by 2030 (den Elzen et al. 2016) and carbon-neutrality by 2060. On the other hand, when legitimizing its involvement in the governance of distant environments—a role that could open the door to future participation in, for instance, the regulation of geoengineering (see, e.g., Dalby 2015)—China focuses on its role as geological victim rather than agent. Like climate change narratives from the Global North, these representations deterritorialize the origins of climate change while firmly territorializing its consequences (Doyle and Chaturvedi 2010). They also fit within the broader discourse that Beijing propagates, which depicts China as a victim of foreign adventurism and great power politics (Callahan 2009; Agnew 2012). Being a casualty rather than a culprit of climate change strategically aligns the country with the developing world in global climate change politics, even as the scale of China's contemporary geological

agency, when measured in terms of greenhouse gas emissions, far surpasses that of the rest of the Global South combined (Fuhr 2019).

Where There's Smoke, There's Melting Ice

Greenhouse gases such as carbon dioxide (CO_2) and methane are found in Earth's atmosphere. Like a blanket, they absorb heat that rises up from the planet's surface. As the amount of greenhouse gases in the atmosphere increases, more heat is trapped, which melts Arctic sea ice and exposes open ocean water. The widening extent of dark water as opposed to reflective, white ice exacerbates these warming trends. China's CO_2 emissions have quadrupled since economic reforms began in 1978, largely due to a fourfold increase in the country's energy consumption (Guan et al. 2008). A majority of this energy still comes from coal, the most carbon-intensive of all fossil fuels, which also pumps black carbon (or soot) into the atmosphere with further warming effects. Between 1950, one year after the Chinese Communist Revolution, and the early 2000s, the country's greenhouse gas emissions from burning coal increased 2,600 percent (Bond et al. 2007). In 2021, China was responsible for 26.1 percent of global emissions (Ge, Fredrich, and Vigna 2021), exceeding the shares of the United States and Europe (the two next-largest emitters) combined. The sector of the Chinese economy that produced the most CO_2 emissions in 2015 consisted of electric power, steam, and hot water production and supply, while the smelting and pressing of ferrous metals (generally for steel manufacturing) came in second (Shan et al. 2018). Illuminating, powering, and heating China and producing steel therefore constitute large and identifiable contributors to Arctic climate change.

All told, China's steel manufacturing sector is responsible for some 4–5 percent of global greenhouse gas emissions (Jing et al. 2014). In 2010, China's iron and steel manufacturing industry emitted 1.82 billion tons of CO_2 (Tian, Zhu, and Geng 2013), a figure that likely rose over the following decade given the sector's continued growth. Even if we take this somewhat outdated statistic, convert it to metric tons (1.65 billion), and multiply it by the 2.7–3.3 square meters of September sea ice that are estimated to be lost per metric ton of CO_2 emitted (Notz and Stroeve 2018), China's iron and steel manufacturing industry is still responsible for the loss of 4,455–5,445 square kilometers of September sea ice every year—an area almost as large as Shanghai (figure 1.1).

The declining amount of Arctic sea ice directly impacts environmental quality and public health in China. Preventing the loss of the Arctic ice cap may help lessen the probability of more frequent extreme winter weather in China. Scientists

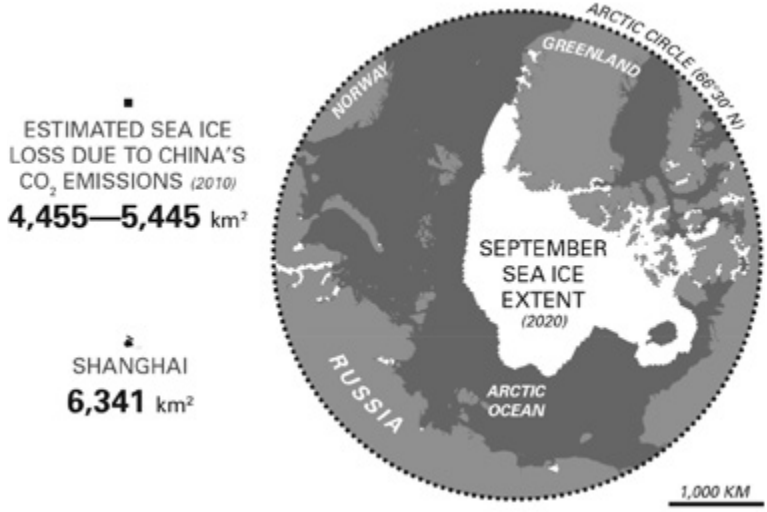

Figure 1.1. Arctic sea ice. (Map by Dorothy Tang. Made with Natural Earth and NSIDC Sea Ice Index data. See NSIDC 2021.)

have demonstrated that a loss of a million square kilometers of autumn Arctic sea ice is linked to increased snow cover and cooler temperatures in northern and central China (Liu et al. 2012). When sea ice thins and retreats, it affects the Arctic Oscillation, an atmospheric circulation pattern around the North Pole and high latitudes. In turn, an altered Arctic Oscillation can cause cold air masses from the Arctic to penetrate the Eurasian and North American continents (Cohen et al. 2014; Francis and Vavrus 2013). These sudden penetrations of cold air exacerbate winter conditions in Eurasia by lowering surface air temperatures and increasing the amount of snow, rain, monsoons, and dust storms (He et al. 2017).

Arctic sea ice reduction is also driving atmospheric shifts that are leading to unprecedented levels of winter haze in China, events colloquially called airpocalypses (Zou et al. 2017). While local precipitation and surface wind influence haze levels above cities in heavily industrialized northeastern China, perhaps surprisingly, Arctic sea ice exerts an even greater impact (H. Wang and Chen 2016). Changing atmospheric circulation patterns due to melting sea ice cause the atmosphere to stagnate over northeastern China and weaken cyclone activity. Winter haze can then hang in place, choking the many cities in the region. As sea ice continues to decline—a phenomenon that has led to increased snowfall in northern latitudes—winter haze and poor regionwide ventilation conditions are likely to persist (Zou et al. 2017).

Even if cities in China take measures to lower the amount of pollutants they are emitting into the air, continued sea ice decline—a process set in motion long ago and difficult to quickly reverse—will keep winter haze in place (H. Wang and Chen 2016). Demands from China's urban population for cleaner air are spurring government initiatives to clear the skies (J. Zhang et al. 2010), and the state is promoting cleaner steel production by closing heavily polluting facilities and encouraging the use of higher-grade iron ore.[4] However, greenhouse gases sent aloft years ago that are shrinking Arctic sea ice may undermine the impacts of these localized environmental policies.

While global climate change mitigation efforts target greenhouse gases, specifically CO_2, one type of emission whose effects may be easier to limit immediately is black carbon (Ding et al. 2016). This particulate matter occurs as a result of the incomplete combustion of fossil fuels, biofuels, and biomass. Black carbon is particularly harmful in the Arctic because when it falls atop snow or ice, it reduces reflectivity, and sunlight is absorbed instead of reflected (Wobus et al. 2016). This darkening effect may warm and melt snow more effectively than any other anthropogenic agent (Qian et al. 2014). Black carbon does not persist in the atmosphere as long as other greenhouse gases: soot remains for just four to eight days (Stohl 2006), whereas CO_2 emissions last for years. Efforts to reduce black carbon can therefore generate a more immediate effect than efforts to reduce CO_2.

As with emissions of greenhouse gases, emissions of black carbon from East Asia are higher than those from any other world region, surpassing those from Europe, North America, and Russia combined (Stohl 2006). They have also risen quickly: black carbon emissions from China have doubled since the 1970s. By contrast, emissions from the former Soviet countries in the late 1990s were less than a quarter of their 1980 peak levels (Koch and Hansen 2005), reflecting the disastrous consequences of the Soviet Union's collapse. Even as China continues to develop and modernize, most of the country's black carbon emissions still come from residential coal burning (R. Wang et al. 2012). Without wishing to absolve governments or corporations of culpability for climate change, it is worth noting that this fact underscores the collective role of individuals, whose responsibility for climate change often goes unaddressed in "Anthropocene blame narratives" (Rudiak-Gould 2015, 59). Black carbon has been shown to travel from western China all the way across the Pacific Ocean to Alaska (Sharma et al. 2013). At the same time, due to the nature of the atmospheric pathways that transport black carbon, emissions from China actually have a lower impact on climate change in the Arctic than those from Europe (Stohl 2006).

Nevertheless, the Chinese government's stated plans to develop Arctic shipping and natural resource extraction will likely lead to an increase in black carbon

emissions from within the Arctic. Approximately two-thirds of the black carbon emitted by Arctic shipping comes from burning heavy fuel oil (International Council on Clean Transportation 2017). While the Polar Code introduced in 2017 by the International Maritime Organization bans the use of heavy fuel oil in the Antarctic, it has taken longer to implement a similar ban in the Arctic, where the economic burden associated with altering industry practices has historically outweighed environmental concerns. In 2020, the International Maritime Organization finally approved a ban on the use of the fuel in the Arctic that will take effect in 2024. However, numerous exemptions will last until 2029. Fortunately, since most Arctic shipping occurs in summer, the resulting black carbon emissions are less likely to be deposited on top of snow and ice (Corbett et al. 2010).

Black carbon emissions from oil and gas extraction may have a more significant impact on Arctic climate change than those from shipping. Drilling occurs year-round, meaning that there is a large window during which black carbon can fall onto snow and ice (Corbett et al. 2010). The practice of gas flaring (burning off excess gas that cannot be exported or sold) contributes 42 percent of annual mean black carbon surface concentrations in the Arctic (Stohl et al. 2013), a figure that is poised to rise due to the opening in recent years of new resource extraction sites. Norway's USD 5.6 billion Snøhvit liquefied natural gas (LNG) project began production in 2007; Russia's USD 27 billion Yamal LNG plant commenced exports a decade later. The Yamal Peninsula, an area primarily inhabited by Nenets reindeer herders before the discovery of extensive gas fields in the 1960s (Forbes 1999), lies below one of the main atmospheric pathways along which air masses travel north to the Arctic (Evangeliou et al. 2018) (figure 1.2). Black carbon emitted there may thus have an easy conduit north, where its warming effects will be amplified. The Yamal LNG project likely would not have been realized without the assistance of Chinese investors, who contributed over USD 15 billion to the project (Pan and Huntington 2016). As such, gas extraction and flaring at Yamal LNG, and the resultant year-round black carbon emissions darkening Arctic snow and ice, are arguably direct effects of Chinese foreign investment.

Yamal LNG, which produced 18.8 million tons of LNG in 2020, or approximately 5 percent of the LNG sold in the global market (Bajic 2021), provides a new source of the commodity for China as it seeks to import more natural gas and reduce its reliance on coal. So, too, may the opening of the Arctic LNG 2 project across the Ob Bay from Yamal, from which China's state-owned Shenergy Group has agreed to purchase three million tons annually. While slated to become operational by the end of 2022, the project may be delayed if Western sanctions levied in response to Russia's invasion of Ukraine prevent key technologies from arriving. Regardless, while China's shift to natural gas will help lower

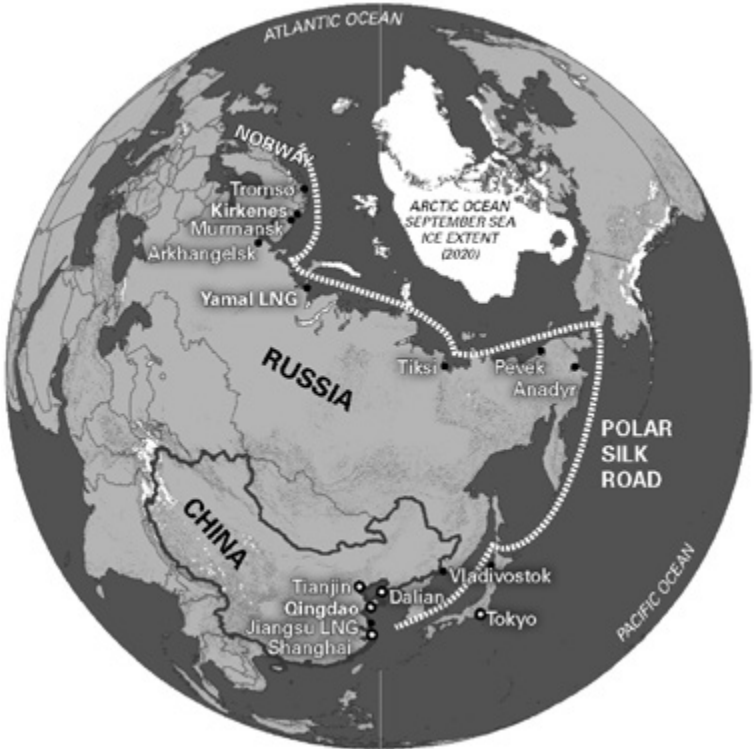

Figure 1.2. The Polar Silk Road. (Map by Dorothy Tang. Made with Natural Earth and NSIDC Sea Ice Index data. See NSIDC 2021.)

domestic black carbon emissions, this will likely increase black carbon emissions within the Arctic, exemplifying China's tendency to offshore domestic environmental hazards (Saha 2020). Ironically, however, any increase in black carbon emissions within the Arctic—particularly from year-round activities such as fossil fuel extraction—may weaken the East Asian winter monsoon and exacerbate winter haze over places like Beijing (Lou et al. 2018). In other words, air pollution may worsen over China's northeastern cities regardless of any drop in local coal combustion. At this point, the so-called Arctic paradox, in which the negative effects of polar climate change are simultaneously creating new opportunities (Finger 2016), may be extended one step further. While the climate-induced opening of new economic sectors may undermine the region's environment, it may also wreak havoc in the very countries promoting these activities, such as China.

China: Geological Agent or Victim?

China's efforts to legitimize its status as an Arctic stakeholder emphasize the feedback loops associated with the region's warming. For the Chinese state, two major implications of being a near-Arctic state are that, first, it could fall victim to Arctic climate change; and second, this risk provides both a reason and a responsibility to act—and perhaps to offer its own model for governance in a region it perceives as a "strategic new frontier" (Andersson 2021). The country's 2018 Arctic Policy states:

> The natural conditions of the Arctic and their changes have a direct impact on China's climate system and ecological environment, and, in turn, on its economic interests in agriculture, forestry, fishery, marine industry and other sectors.
>
> China is also closely involved in the trans-regional and global issues in the Arctic, especially in such areas as climate change, environment, scientific research, utilization of shipping routes, resource exploration and exploitation, security, and global governance. (State Information Office of the People's Republic of China 2018)

In just two sentences, the policy juxtaposes the impacts China faces from Arctic climate change with the country's ability to manage Arctic affairs. The phrasing also reproduces the tendency of climate change narratives to refrain from blaming any particular actor (Rudiak-Gould 2015). China's Arctic Policy draws attention to the hazards brought about by a changing physical environment instead of to the reasons they are occurring—one of which is the country's own geological actions.

At the same time, China readily draws attention to itself as a victim of climate change. China's Arctic Policy, like the state's wider discourse on climate change, focuses on the country's vulnerability rather than its culpability (Spangenberg 2014). This presumption of vulnerability is not unfounded: of the ten major coastal cities most at risk of economic losses caused by flooding due to a rise in sea levels, two, Guangzhou and Shenzhen, are in China (Hallegatte et al. 2013). Moreover, half of Shanghai could be flooded by 2100 due to a combination of sea level rise, land subsidence, and storm surges (J. Wang et al. 2012).

At various forums, including two major international conferences on Arctic development that I attended, Chinese officials have underscored the country's vulnerability to melting ice sheets and rising seas. At the annual Arctic Circle

Assembly in October 2017 in Iceland, China's Vice Foreign Minister Zhang Ming stated, "The changing natural environment and resources exploration of the Arctic have direct impacts on China's climate, environment, agriculture, shipping, trade, as well as social and economic development" (Zhang 2017). Then, at the Arctic Circle Forum in May 2019 in Shanghai, Wang Hong from the State Oceanic Administration of the Chinese Ministry of Natural Resources said, "Shanghai and a lot of other cities around the world are so closely related to the developments in the Arctic, so what is important is that we should use cooperation to override the distance" (field notes, May 10, 2019).

Both officials sidestepped the responsibility for climate change of actors within China, from individuals to private firms to state-owned iron and steel giants. Instead, they described climate risks as emanating from an unstable and unpredictable physical environment. The thawing, cracking, and fast-melting region is portrayed as out of control, even though many of these changes are directly attributable to national, and ultimately controllable, actions.

China is not unique in claiming to be a victim of climate change. Trinidad and Tobago, which has become one of the wealthiest countries in the Caribbean and Latin America thanks to a century of oil and gas production, is a smaller-scale example of a country that positions itself in the "victim slot" in climate change narratives, despite having one of the world's highest levels of CO_2 emissions per capita (Hughes 2013, 571). Both cases demonstrate how geological agency is generally cast at the planetary scale (if it is mentioned at all), while geological victimhood is scaled nationally.

Even as Chinese officials exculpate their country from responsibility for climate change, they readily promote China's willingness and capacity to influence development in regions affected by climate change and global governance of that change. Together, these narratives of victimization and intervention present the country as taking defensive rather than offensive action, making its wielding of geological agency potentially more palatable to the global community.

Such a discursive strategy may already be working in locales such as Iceland, which over the years has demonstrated a willingness to work with the Chinese government on issues ranging from energy development to scientific cooperation. The country's former president, Ólafur Ragnar Grímsson, has championed increased Asian engagement in the Arctic (Tonami 2014) as part of his efforts to broaden global participation in the region's development. In 2013, Grímsson helped initiate the aforementioned annual Arctic Circle Assembly. Spin-off events are held in various cities around the world, including Shanghai in 2019. In his speech opening the event, Grímsson stated:

> Often, as I speak in different parts of the world, I am asked, "Why is China so interested in the Arctic?" The answer is in fact very simple: the aggressive melting of the Arctic sea ice, which has been taking place with increasing pace in recent years, causes extreme weather patterns and fundamental destructions in China only a few months later. The melting of the Greenland Ice Sheet, which also has been happening faster than any scientific institution predicted in recent years, will raise sea level all over the world. And if only a quarter of the Greenland ice sheet melted, it would lead to two meters' rise in sea level everywhere, making the great cities on the coast of China uninhabitable. And as I said to the distinguished vice mayor of Shanghai, who is with us here this morning, the security of Shanghai in the future will be determined in the Arctic. (Grímsson 2019)

Grímsson thus endows the Arctic with a level of geological agency that threatens China, while failing to mention China's responsibility for contributing to sea level rise.

While the Chinese government is taking major steps to reduce its greenhouse gas emissions, its climate change policy is largely driven by economic rather than environmental motives (Z. Zhang 2003). Rather than devoting attention to the country's climate change mitigation efforts, for instance, China's Arctic Policy reflects upon the ways in which the state and Chinese enterprises might leverage new opportunities, such as developing oil and gas, shipping, fishing, and tourism.

China has become a world leader in constructing the necessary infrastructure for many of these industries as a result of technological advances achieved by its steel industry—the very sector responsible for 4–5 percent of global greenhouse gas emissions and for a nonnegligible percentage of Arctic sea ice melt, as described earlier. Ice-class vessels that can be exported to Arctic countries have thicker hulls and extra structural components that require steel welded at very high temperatures (Song and Zhang 2013). The United States, Japan, and Korea have traditionally dominated this advanced form of steel manufacturing. Yet in 2018, China's HBIS Group, the world's second-largest steelmaker, successfully developed the technology to manufacture polar-class steel (P. Zhang et al. 2018). This advance enables China to construct polar-class vessels, which has been a policy objective since China released its Thirteenth Five-Year Plan in 2016 (Eiterjord 2020; Compilation and Translation Bureau 2016).

For the time being, Chinese state-owned enterprises are building ice-class vessels for two main purposes: first, for domestic needs, as with the icebreaking research vessel *Xue Long 2* (China's second icebreaker, constructed in a Shanghai shipyard and launched in 2018); and second, for export to foreign countries and

companies seeking to break through melting Arctic ice for commercial purposes. In 2018, China entered the market for ice-class expedition vessels when the state-owned China Merchants Heavy Industry began building ships for cruises to the Arctic and Antarctica, with the first ship delivered to Miami-based Sunstone Ships in 2019. Also in 2018, using a design licensed by Finnish engineering company Aker Arctic, Guangzhou Shipyard International built China's first Arc7 ice-class condensate tanker, *Boris Sokolov*, to export condensate (a type of light oil) from Yamal. The vessel can travel in temperatures as low as -50°C and in ice up to 1.8 meters thick. As Chinese shipyards seek to produce more ice-class vessels for navigating the Arctic, whose black carbon emissions will undoubtedly exacerbate melting, future analyses should examine not only China as a geological agent, but also its steel and shipbuilding sectors.

China's ability to participate in Arctic development is made possible physically by the country's greenhouse gas emissions, and discursively by rhetoric that positions China as a victim of climate change. Together, these material and rhetorical actions enable China to intervene in the region and, in the words of its Arctic Policy, "create favorable conditions for mankind to better protect, develop, and govern the Arctic" (State Council Information Office of the People's Republic of China 2018). Such altruistic and universal language accords with China's repeated advocacy of a "community of common destiny" (D. Zhang 2018), both in the polar regions and worldwide. Yet this unifying lens neglects the fact that China's industries, which are well-positioned to develop the Arctic, bear particular if partial responsibility for undermining the region's ecological and geophysical processes and Indigenous Peoples' traditional ways of life, many of which are ice-dependent. The Chinese government appears ready to tackle climate change while leveraging new economic opportunities arising from it. In this sense, China is concurrently attempting to limit and exploit the effects of its geological agency. In terms of the norms and narratives it constructs and circulates, however, the Chinese state seems relatively unwilling to admit its responsibility for instigating the Anthropocene—or, more precisely, the Sinocene—in the first place.

Conclusion: The Ephemerality of Geological Agency

In tracing the specific processes responsible for the Anthropocene, social scientists have suggested terms like "Capitalocene" and "Plantationocene" (Haraway 2015; see also Carney 2021; Jason Moore 2017, 2018), drawing attention to the responsibility of capitalism, colonialism, and racism for climate change. Another more nuanced interpretation of the Anthropocene, in line with the rise of geological as opposed to strictly geopolitical politics, might be the Sinocene. Climatic

and industrial shifts within China are directly and indirectly altering the Arctic's natural and built environments. Greenhouse gases originating from China's cities, steel mills, and power plants are melting sea ice, the shrunken remains of which are being smashed through by new, steel-based infrastructure built in Chinese shipyards. China is not just a geopolitical force: the rising power has become a geological agent, too. Greenhouse gas emissions from industrial sites like Chinese steel mills are melting Arctic sea ice, which in turn affects atmospheric circulation patterns that disrupt weather in Chinese cities.

At the same time, thawing sea ice helps produce new economic opportunities such as longer shipping seasons in the Arctic. While mariners have plied the Northern Sea Route for centuries, their journeys, especially in the ice-clogged eastern section leading toward Asia, have typically been confined to summer. In July 2018, the first delivery of liquefied natural gas from Yamal reached the Rudong LNG Terminal in Jiangsu Province, not far from the Shanghai shipyard where *Xue Long 2* was launched two months later. Then in January 2021, for the first time, three ice-class LNG carriers traversed the route from Yamal to East Asia without icebreaker escorts. These pioneering voyages demonstrated the increasing feasibility of year-round shipping from the gas-rich peninsula in northern Siberia to destinations to its east. The shipping route that Chinese officials refer to as the Polar Silk Road is not a discursive sleight of hand: it is a geophysical reality.

Grandiose Chinese government undertakings such as the Belt and Road Initiative and the Polar Silk Road are often criticized as "smoke and mirrors" (Russell 2018). Admittedly, Beijing's foreign policy strategies have not yet spurred the wholesale realignment of the world's infrastructural corridors. But China's domestic greenhouse gas emissions are already producing environmental changes in faraway regions, which serve as the literal groundwork on top of which China may be able to materialize its developmental visions. In the meantime, technological changes within China are enabling the country's industrial sectors to take advantage of geophysically transformed environments.

So far, despite increased commercial opportunities, the Chinese government has not managed to turn a warming polar climate entirely to its favor. Diminished Arctic sea ice is increasing the number of winter haze days in Chinese cities and affecting polar atmospheric circulation patterns, which may send more severe snowstorms and colder temperatures to the country's northern regions. The recurring observation that activities within the Arctic reconfigure the region's physical environment (Depledge 2015) is thus only half the story. Environmental and geophysical shifts in the circumpolar north affect conditions elsewhere on Earth, too.

If enough ice disappears, there could come a time, perhaps centuries from now, when China's homegrown polar-class technologies are less in demand. Rapid

responses to combat or profit from climate change may accelerate shifts in the natural environment, making ambitions like the Polar Silk Road ultimately fleeting geophysical realities. As geology changes faster than ever, so too may geological politics. While humans "will remain a major geological force for many millennia, maybe millions of years, to come" (Crutzen 2006, 17), whether China remains a geological agent for very long remains to be seen.

Notes

1. An earlier, French-language version of this chapter was originally published as "De glace, de fumée et d'acier: La géo-ingénerie chinoise sur la route de la soie polaire" (Ice, smoke, and mirrors: Chinese geoengineering of the Polar Silk Road), in *Les nouvelles routes de la soie* (*The New Silk Roads*), edited by Frédéric Lasserre, E. Mottet, and B. Courmont (Québec City: Presses de l'Université de Québec, 2019) 119–140.
2. See Crutzen 2002; Steffen, Crutzen, and McNeill 2007.
3. See Davis and Todd 2017; Haraway 2015; Jason Moore 2017, 2018.
4. Chinese demand for higher-grade iron ore is driving up the price of the resource in the Arctic, which is home to many high-quality deposits. At the LKAB iron ore mine in Kiruna in northern Sweden, a manager I interviewed on August 19, 2019, remarked that the reason for the rise in prices was that "the Chinese authorities decided that Chinese people should be able to see blue sky."

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CHAPTER TWO

Geosocial Formations and the Petroleumscaping of Singapore

Underground Landscapes as Infrastructural Territories

ANDREW TOLAND

A hundred and thirty meters below an artificial inlet set into an unnaturally shaped island just off the southern coast of Singapore lies a vast array of gigantic artificial caves called the Jurong Rock Caverns. The caverns are filled with various forms of liquid hydrocarbons and derivative products. This massive piece of infrastructure, like the larger national petrochemical facilities of which it forms a part, is a central node in the global fossil fuel economy. Singapore hosts the largest oil bunkering facilities in the world (MPAS n.d.), where oil is stored to refuel the ships that cycle endlessly between the manufacturing centers of East Asia, the consumer markets of Europe, and much of the rest of the world—an endless armada passing to and fro through the Strait of Malacca, west of Singapore.

The Singaporean government constructed and is continuing to expand the Jurong Rock Caverns both to bolster Singapore's petrochemical industry—it is reportedly the world's third-largest oil refining center (Tan 2017) and the world's third-largest oil trading hub (ITA n.d.)—and to underwrite its continued strategic importance for global maritime trade. In spite of extensive coastal reclamation, Singapore's scant land resources on the surface have impelled government and industry to view the subsurface as a new frontier for infrastructural development. However, the significance of the Jurong Rock Caverns goes far beyond the economic. Certainly, the caverns exemplify the roles of large-scale, state-sponsored infrastructure and of the transport and logistics industries in the story of Asia's modern development. But the caverns can also be read in other ways: they reveal the history of value judgments about landscapes and the construction of national territory; they bind narratives of national identity to economic and material transformations; and they operate as an assembly through which the circulation of fossil fuels, technological imaginaries, and economic life come together with the implacable realities of geological time, the processes of matter, and the geochemistry of climate.

Part of the national discourse of Singapore since independence is that it has been engaged in an ambitious and determined game of catch-up with the rest of the developed world, which it has now surpassed on many measures.[1] Now that

Singapore has overtaken much of the rest of the world, the stated objective of its government is to stay ahead, in what government discourse tends to characterize as a cutthroat struggle for global economic survival.[2] The Jurong Rock Caverns have been cast as one of many examples that instantiate this national discourse.

This chapter shows how the caverns also represent an opening onto myriad other dynamics—national and international, historical and projective, material and representational, technological and environmental—that we might fruitfully begin to probe in order to understand the deeper currents in the history of infrastructure and modernity in Asia. I argue that the Jurong Rock Caverns are just one part of the national terraformational project of Singapore: not only engineering and economic achievements, they are also a geosocial project that discursively constructs Singapore's transformation from a landscape with no natural endowments to one that can create innovation, value, and advanced knowledge at will.

Scale is an important factor here. The caverns project is not merely driven by the engineering imperatives associated with large-scale infrastructure; it also serves the Singaporean government's rhetorical strategy of forever renewing the superlatives that can be attached to the small nation. And not just physical scale is at play here. So is a more immaterial contrast of scales, constantly repeated for the benefit of both domestic and international audiences to burnish the technocratic and visionary credentials of the ruling People's Action Party. In the case of the Jurong Rock Caverns, it is petroleumscaping in particular that effects this heroic construction of artificial grounds and undergrounds, transforming, in the words of Lee Hsien Loong, Singapore's prime minister, seven small offshore islands into economically and socially lucrative "thinking space, international space, and development space" (Lee 2014).

A Light at the End of the Tunnel

On February 8, 2007, Singapore's minister for trade and industry stood in front of a large papier-mâché rock face and set off a mock explosion with a cardboard detonator. Through the magic of stagecraft, this blasted a hole in a wall of styrofoam rocks, which theatrically tumbled down to reveal the interior of a dramatically lit cave. This rather overblown piece of theatricality marked the climax of the groundbreaking ceremony for the Jurong Rock Caverns development (*Straits Times* 2014).

In his speech for the occasion, the minister, Lim Hng Kiang (2007), reiterated many of the talking points that have long characterized Singapore as an ambitious developmental state: the project was a "first" of regional significance; it contributed to Singapore's consolidation as "a global [oil and] chemicals hub"; it was part

of the Singaporean government's commitment to give "current and future investors in Singapore" certainty about industry prospects; it was a manifestation of Singapore's "spirit of constant innovation" as well as "hard work, imagination, and perseverance"; and it demonstrated Singapore's determination to maintain its "competitive position" and stay ahead in a "fast-changing and dynamic competitive environment."

At the same time, Lim's speech revealed certain things about the way geology, land, and space are brought together within the project of Singapore's developmental state and in its political economy and political ecology. And it revealed a series of both emphases and elisions in the state's official discourse about the materials, processes, and systems mobilized for the project: capital, geotechnical knowledge and construction methods, global petrochemical trading networks, and the labor of construction workers (mostly migrants in Singapore on short-term visas). Other historical legacies, equally absent from the official narrative, also came along with the project as its inevitable stowaways: histories of land modification in Singapore, the island's long role in the global trading system, its perennial discourse of resource and land scarcity, the social engineering of the People's Action Party, and the country's perpetual geostrategic recalibrations in the face of shifting regional and international power dynamics.

When the project formally opened in 2014, Singapore's prime minister, Lee Hsien Loong, officiated. This time there was no choreographed blasting open of ersatz rock. Instead, Lee stood behind a large, altar-size slab of actual rock alongside three other officials. They each pressed four oversize buttons attached to the rock's surface. The buttons lit up, and (one was meant to assume) the first flows of liquid hydrocarbons into the underground chambers of the caverns were set in motion. Lee's accompanying speech repeated many of the same tropes that Lim's speech seven years earlier had featured, but it also contained some interesting asides, as well as broadening the claims about what this instance of underground infrastructure might represent for Singapore. Lee introduced the project by going straight to one of the organizing narratives of Singapore since independence—a narrative that had been passionately and frequently articulated by his father, Lee Kuan Yew, the country's founding father and long-serving prime minister—that the nation was a territorially constrained and land-scarce city-state with no endowments of natural resources, constantly in search of a means of existence for its people. Lee Hsien Loong began:

> Ladies and gentlemen:
>
> I am delighted to be here this afternoon to open the Jurong Rock Caverns. This is Southeast Asia's first commercial underground liquid hydrocarbons storage facility and we got it here in Singapore.

> In land-scarce Singapore, we are always trying to create new space—to support growth, to create jobs, and to build homes for our people.
>
> Two months ago, I met the Board of Halliburton. They were having their board meeting here. They asked me this same question—how is Singapore going to expand our physical land area [*sic*].
>
> I explained to them that Singapore's land constraint is a little bit like Peak Oil. It exists, there is a theoretical limit. But with ingenuity, determination and technology, that limit can be quite a way off! And as you approach it, hopefully we can push it even further off in the future.
>
> Take Jurong Island, where we are at now. (Lee 2014)

The anecdote about Halliburton's board seemed intended to encode a number of further messages. First, it demonstrated Singapore's leading status in the global petrochemical industry, and in the global economy more broadly; the world's leading oil services company could just as legitimately hold its board meeting in Singapore as in Houston.[3] Second, it offered an opportunity for Singapore, the scrappy Asian upstart, to school a global corporate behemoth; both were facing the constraints of a finite resource, but with "ingenuity, determination and technology," a future crisis might be indefinitely deferred.

Lee was subtly continuing a favorite theme of his and his father's "Asian values" discourse (e.g., Barr 2007). In this context, Jurong Island and the underlying Jurong Rock Caverns project come to stand for broader formations of Singaporean national identity, as well as for the social and cultural engineering necessary in the pursuit of long-term national economic strategy. These are the very themes distilled in the goal statement that opened Singapore's 2010 strategic economic planning document: "high skilled [*sic*] people, innovative economy, distinctive global city" (Singapore Ministry of Finance 2010). In the discourse of the Singaporean government, the Jurong Rock Caverns are promoted as a signal example, mobilizing imaginative (even fantastical) infrastructural and technological creativity; significant financial and intellectual capital; deliberate reconfigurations of material realities; and an astute, carefully calibrated positioning of the country within regional and global economies and resources.

In addition to peak oil and peak land, Lee's speech also touched on the threat of another sort of limit: "JRC [the Jurong Rock Cavern development] shows that we are determined to develop the petrochemical industry here, despite our land constraints, and also despite the potential impact on our petrochemical industry of a United Nations Framework Convention for Climate Change agreement on carbon emissions which is presently being negotiated by the countries of the world" (Lee 2014). Ostensibly, this statement seemed intended to reassure investors and

to signal certainty in the face of the impending Paris Agreement, affirming the stability and continuity of government policy in an unpredictable international context. Lee then noted that the petrochemical industry accounted for a third of Singapore's manufacturing output—signaling that Singapore had as much skin in the game as any private investor.

At the same time, the statement offered no concrete indication of how the risk of climate change and the need to limit carbon emissions might be managed. Instead, it seemed to signal an implicit bet: that the region's demand for oil and petrochemical products would always prevail against any international agreement on carbon emissions reductions, and that self-interested realism would always trump idealism in international relations and multilateral frameworks. One might interpret this as a bet on the teleology of Asian modernity (the ultimate metaphorical light at the end of the tunnel): that it is an inevitable trajectory built on the demands of ever-increasing material standards of living, and serviced by a state-mobilized infrastructural imaginary of ever-increasing productive capacity, logistical efficiencies, and technological innovations. Nevertheless, the Jurong Rock Caverns project offers a curious instance of this infrastructural imaginary's rubbing up against the exigencies of anthropogeological forces moving inexorably in the opposite direction.

An (Un)Natural History of Politics: Singapore as a Terraformational Project

Even before discussions about the Anthropocene emerged, first in the sciences and humanities, and then in broader discourse, geologists had begun to speak of anthropogeomorphology—the association of geomorphological conditions with the anthropogene, or the landscape as modified by humans, especially in urban contexts (Coates 1984). One of the early studies in this field was Avijit Gupta's 1987 "Urban Geomorphology in the Humid Tropics: The Singapore Case." Even then, the "Singapore case" offered a rich example of just how much a natural geomorphology could be altered in the service of urbanization and economic development. More recently, "political geology" (Bobbette and Donovan 2019) and the slightly earlier "geosocial formations" (Clark and Yusoff 2017) have offered ways in which social and political-economic dynamics may be read as imbricated with geological phenomena, and vice versa. This corrective to the blander discourse of the Anthropocene allows geophysical, biopolitical, and social conditions to be considered in terms of "geologic capacities" and "geologic subjectivities," tying together fossil fuels and the modes of existence under late capitalism that the energy source underpins in what Kathryn Yusoff (2013, 780, 791) calls "geologic life."

The Jurong Rock Caverns, and the larger terraformational project of Singapore of which they form just one part, can be interpreted as an expression of such geosocial formations. In both the colonial and modern periods, Singapore has always been geosocial, insofar as the habitation and identity of the island was always dependent on geographic and geological contingencies: its geophysical status as an island separated from the Malay Peninsula, its geostrategic location in relation to the Strait of Malacca, and its shortage of buildable land. The Jurong Rock Caverns can be thought of as a contemporary extension of this history, a new phase in the geosocial life of the territory.

When the British commenced the formation of Singapore as part of their colonial project, the geosocial life of fossil fuels was only in its infancy. Britain's geostrategic maneuverings in the region were focused on the Strait of Malacca as a choke point on the trade routes of the global spice economy and of the India–Southeast Asia–China commodity trade, in which the British competed with the Dutch as well as with local powers. In many ways, this was simply a continuation of the strategic trade role that the strait had played since at least the first millennium CE under the (partial) control of the Srivijayan Empire, and under the later overlapping structures of the Islamic-based trade system.[4]

By the middle of the nineteenth century, however, reorientation was well under way: both toward fossil fuels (first coal and later oil), and toward the evolution of the Western colonial trade system into the present globalized economy, in which carbon-based energy plays such a major part. Singapore's strategic role straddling East Asian and European trade continued to strengthen with the technological shift to coal-powered steamships, whose use both cut travel times and increased volumes (Clarke 2006).

As noted above, the conventional narrative of the history of Singapore's land reclamation projects is built on a discourse of land scarcity. But another approach to the issue is to consider this history in relation to the formation of global transportation infrastructures. Port cities tend to experience some of the most intensive land transformations because they reshape coastal or river edges and floors to suit the needs of shipping, and reconfigure adjacent land in the service of the associated warehousing and logistics (Graf and Chua 2008). Within three years after Britain established the colony of Singapore in 1819—founded with the strategic intention of challenging the predominance of Dutch ports in the region—the British had begun clearing "impenetrable forest" and demolishing hills in order to fill in the mangrove wetland on the south side of the Singapore River and create Boat Quay. The north bank was occupied by the local Malay *temenggong*'s (viceroy's) compound and the village under his jurisdiction (Dobbs 2003, 19–20). By the 1860s, the port activities of Singapore had outgrown the original site at Boat

Quay, as the British settlements in the strait grew and their trade within the British colonial system increased—a change boosted by the opening of the Suez Canal in 1869. From the second half of the nineteenth century onward, the entire southern coastal edge of Singapore underwent successive transformations until the land area of the island had been increased by a quarter of its original size (figure 2.1[5]).

Retrospectively, these developments tend to be described as driven by the imperatives of land scarcity in the face of a growing population, but a careful reading of successive reclamation schemes reveals that these were as much social engineering projects as infrastructural ones. These colonial reclamation projects were driven by a desire to spatially order the settlement in such a way as to keep the Indigenous Malay and the growing Chinese immigrant populations in check, while constantly working to improve infrastructure for the British merchants and to facilitate trade and commerce. The focus on developing port infrastructure did not just entail reconstructing the waterfront edge: opening up new port areas demanded reconfigurations both of the commercial districts that serviced them, and of the transportation links that connected them. When a new port at Tanjong Pagar was established and the Singapore River docks were expanded with additional reclamation at Telok Ayer, the intervening hill ranges of Mounts Wallich and Palmer needed to be reshaped to allow the construction of direct roads linking the original commercial district and port with the new port at Tanjong Pagar.

This pattern was repeated throughout Singapore's colonial and postcolonial history: the development and consolidation of Singapore's internationally oriented economic ambitions necessitated continuing development and consolidation of its landforms and spaces, as well as the intensification of its use of land and the land's productivity. In the period after independence, the most notable example is the vast thirty-year East Coast Reclamation Scheme initiated by the Housing Development Board, which transformed a "bare expanse of new coastal land" into a "new skyline" for Singapore, with new "commercial centres, hotels and luxury apartments, low and high density housing" and "miles of beaches and acres of parkland" (Campbell 1971).

The formation of Singapore since independence has been an ongoing project, not just to reengineer space, but also to reorder other elemental conditions of life (air, water, and food)—not to mention its human subjects (Wilkinson 1988). Joshua Comaroff (2017) has shown how Lee Kuan Yew attempted to engineer the very air of Singapore (he believed that the optimal temperature for a vigorous and productive life was twenty-two degrees Celsius). Similarly, Mark Usher (2018, 331) has tracked how Singapore's water infrastructure encodes a "lively" biopolitics of fluid assemblies of bodies, infrastructure, and natural systems in service of the

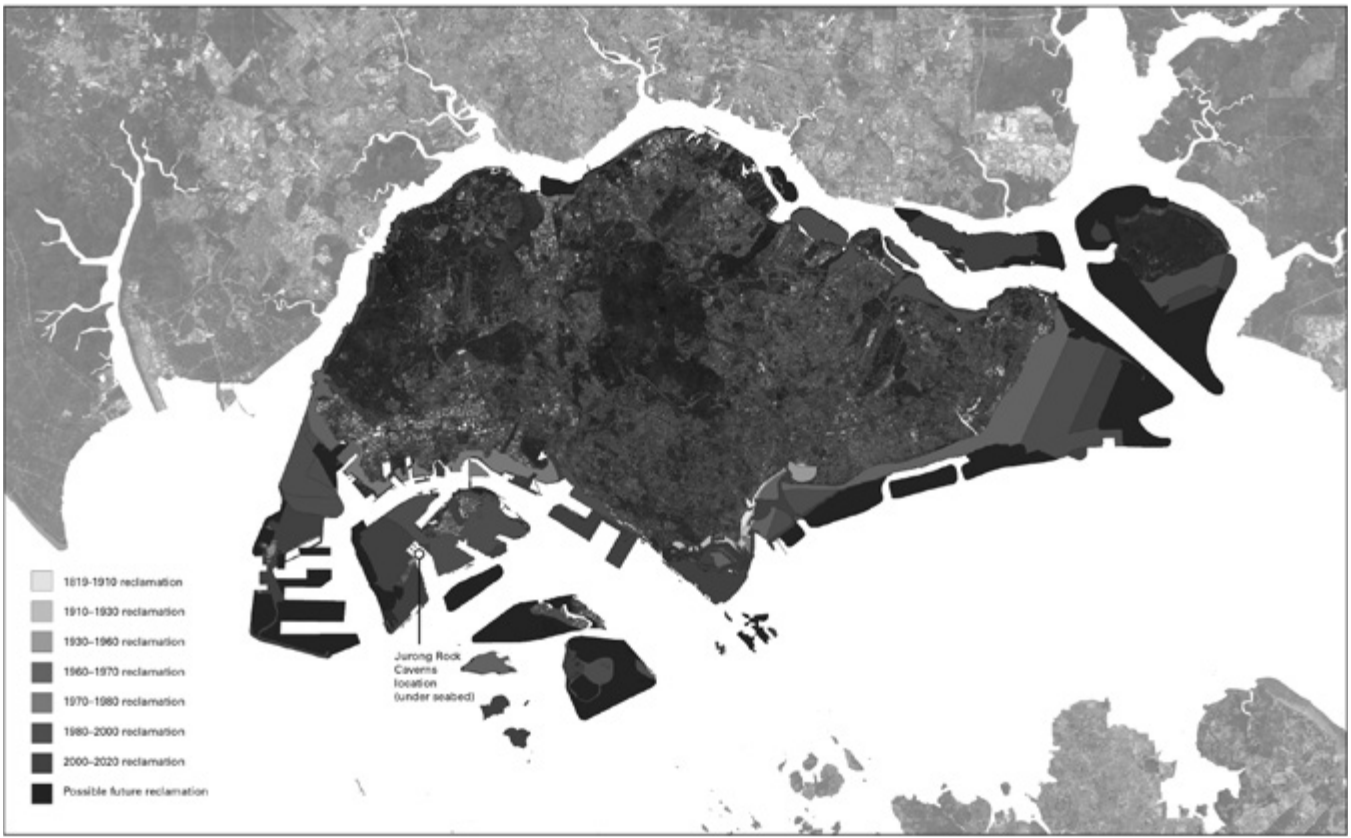

Figure 2.1. Singapore's history of land reclamation. (Map by Andrew Toland and Daniel Rooke.)

shifting objectives of Singaporean modernization. But precisely where and how the terraformation of new spaces should take place in Singapore has depended on long histories of cultural meanings assigned to land and environments, as well as to the Singaporean state's reading of international trade and economic dynamics.

Petroleumscaping Singapore

Carola Hein (2018) has advanced the notion of "petroleumscape" to speak of the global network of spaces, physical and financial flows, representations, and cultural imaginaries that have been mobilized by powerful state and private actors to shape a vast fabric of landscapes, cities, buildings, infrastructures, and the very modes of life in urban and nonurban territories alike. As she (2018, 888) notes, "connecting the actual places where oil has a hold with the *representation* of these spaces and of the *practices* of petroleum products . . . points to a better understanding of the ways in which oil shapes behaviors and secures continuous production and expansion of its spaces, thus creating a feedback loop."

To understand the infrastructure of Singapore's Jurong Rock Caverns as a petroleumscape requires realizing that an important dimension of Singapore's historical formation is related to the history of the global fossil fuel economy. The story of the Jurong Rock Caverns is not just the story of the construction of a vast underground oil storage facility: the caverns are only the latest expression of the reshaping of Singapore in the service of the global oil system.

As Singapore's strategic significance as a regional oil hub grew, the topography of the entire southwestern coast of the territory and its outlying islands was literally reshaped in the service of that growth. In the narrative presented by the Singaporean government, Singapore's participation in the global oil economy allowed the transformation of "barren rock" (Goh 2000) into productive land. Just as reclamation allowed the land of Singapore's urban areas to be consolidated and expanded in the service of colonial trade, and ultimately transformed into a new globalized skyline, the reclamation of Singapore's southwestern coast and islands allowed the consolidation of colonial energy resource systems and independent Singapore's post-war petrochemical industries. The most recent iteration, the Jurong Rock Caverns, operates as an underground analog to the intensification of land use and productivity offered by the contemporary skyscrapers of Singapore's new commercial and residential developments.

The first petroleum depot was established in Singapore in 1891 on the island of Pulau Bukom Besar (now Pulau Bukom) by M. Samuel and Company, Limited, a London-based trading company. Founded in 1832 by Marcus Samuel with a focus on trade with the Far East, the company realized early the global potential of the

oil trade, and in the 1880s it began shipping case oil (five-gallon tins packed as pairs into wooden crates) from the Black Sea oil fields of Russia to rapidly industrializing Japan. By 1888, this venture had become so successful that the company commissioned three custom-designed ships, the world's first oil tankers, to transport oil in bulk: the *Murex*, the *Clam*, and the *Conch* (named after the shells that were the most successful early imports of Samuel's London antique shop).[6] M. Samuel and Company's Singapore depot was established as a regional hub and distribution center as part of the company's trade in Russian kerosene (Moey 1991, 27–28).[7] The Singapore storage facilities formed part of the company's network of oil trading infrastructure across Asia, which was linked to other facilities in Kobe, Hong Kong, Shanghai, Saigon, Bangkok, and Jakarta.

In the period of around a decade at the start of the twentieth century, the use of oil and oil derivatives rapidly shifted from urban and industrial lighting fuel to fuel for internal combustion engines in transportation and industry, completely reconfiguring the geography of resources, mobility, and territories, and causing demand to explode. The first diesel-powered ships were launched in 1903, and by 1912 the British Admiralty directed that all warships be converted from coal to oil. This transition consolidated Singapore's strategic position in the global fossil fuel system, and Singapore became the base for Britain's Far Eastern fleet. The Singapore naval base at Sembawang, constructed between 1923 and 1938 on the northeast coast of Singapore, stored enough oil reserves to fuel the fleet for six months (Murfett, Miksic, and Farell 2011, 155). While the British Navy built its vast oil storage infrastructure on the north of the island, on Pulau Bukom, off the southern coast of Singapore, the Asiatic Petroleum Company continued to develop and expand its facilities, principally through ongoing reclamation. By 1942 the island housed sixty storage tanks and five wharves, setting in place the basis for Singapore's post-war and post-independence petrochemical economy. Although many of these facilities were damaged during the war, what remained was a terrain that was sufficiently petroleumscaped (with reclaimed and leveled islands, cleared sites, and strategically developed port infrastructure) such that the industry could be rapidly revived after 1945, and especially after independence in 1965.

The process of reclaiming and developing seven separate natural islands to form Jurong Island began during the rapid expansion of Singapore's petrochemical industry in the period immediately after independence. In 1968, the minister for law and national development announced to Parliament that the government had acquired the whole of the island of Pulau Ayer Chawan, and that the Jurong Town Corporation had negotiated the lease of that island to Esso for the development of an oil refinery costing SGD 200 million (about USD 65 million). The refinery's development required the creation of an additional 332 acres of land by reclamation,

which was undertaken and paid for by Esso (Parliament of Singapore 1968). This pattern was repeated on Pulau Ayer Merlimau, leased to Singapore Petroleum Co. (Pte.) Ltd., and on Pulau Pesek, leased to Mobil and other oil companies in 1971 (Parliament of Singapore 1971a, 1971b).

The most ambitious scheme, first conceived in the 1980s and aimed at focusing even more of Singapore's manufacturing strategy on the petrochemical sector, was a proposal to construct a thirty-two-square-kilometer artificial island by consolidating and reclaiming the area around the seven existing islands off the southwestern coast of Singapore: Pulau Seraya, Pulau Ayer Merbau, Pulau Sakra, Pulau Pesek Kecil, Pulau Pesek, Pulau Ayer Chawan, and Pulau Merlimau—in other words, binding all the islands of the different multinational oil companies into a single mega-island (figure 2.2[8]). On October 14, 2000, Goh Chok Tong, then Singapore's prime minister, officially opened Jurong Island. In narrating the story of its development, he described the seven original islands as "seven pieces of barren rock," and he noted that visionary feats of geotechnical engineering and marketing had "convinced over 60 leading petroleum, petrochemical, specialty chemical and supporting companies to hub on Jurong Island" (Goh 2000). The achievement was not only the creation of land out of empty seawater and barren rocks, but also the selling of it: "Selling stretches of seawater, with only the promise of land sometime in the future, must surely be more difficult than selling ice cream to Eskimos!" (Goh 2000).

As the petroleumscaping reclamation of Jurong Island has progressed and been augmented with the addition of the Jurong Rock Caverns, the site has come to figure prominently in the Singaporean state's discourse of national economic achievement, making the prefix "Jurong" itself a metonym for such wizardry. In his speech at the opening of the Jurong Island Road Link, Lee Hsien Loong (2000), then deputy prime minister, said:

> The name, Jurong, has become synonymous with national entrepreneurship. . . . Jurong was associated with our bold move, starting in the 1960s, to industrialise the economy. We transformed the swamps of Jurong into industrial land and the Jurong Industrial Estate that we know of today.
>
> Today, Jurong Island has also become a symbol of national enterprise. Here, we conceived and built an integrated petrochemical industry complex out of coral reefs and a scattering of small islands. Without any oil or natural gas of our own, we have brought together on the island a collection of upstream and downstream petrochemical plants that supply one another, create synergies for each other, and make viable the whole complex ecology of different operations and products, where a single plant could not survive.

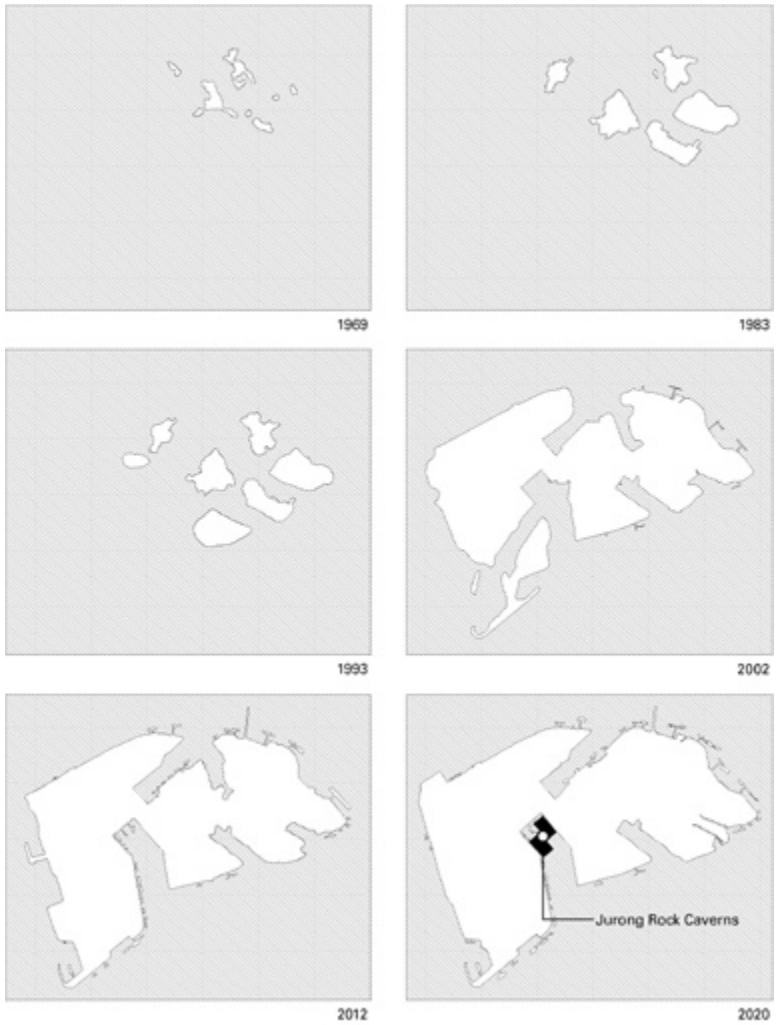

Figure 2.2. Reclamation of Jurong Island. (Map by Andrew Toland and Daniel Rooke.)

In this presentation, "national entrepreneurship" is the alchemy that transformed the natural ecology of swamps, "barren rock," coral reefs, and seawater into a much more valuable "ecology" of oil. But this achievement is not just a story of sectoral integration and infrastructural efficiencies. A more fundamental ecology also had to be engineered—an ecology that brought the bedrock under the sea and Singapore's human capital into a closer relationship.

Forming Jurong and the Jurong Formation: Engineering the Nonhuman and Human Frontier

If the Jurong swamps offered a tabula rasa for industry and manufacturing, and the "barren" islands that were demolished, amalgamated, and absorbed allowed the formation of the artificial petrochemical paradise of Jurong Island, the ground beneath Jurong Island and its surrounding waters presented an even blanker slate—it did not fit into any preexisting landscape discourse. It offered the prospect of the creation of land entirely without nature. Here in particular, Rosalind Williams's (2008, 4) reading of the cultural space of the underground becomes acutely relevant:

> The underworld setting . . . takes to an extreme the displacement of the natural environment by a technological one. It hypothesizes human life in a manufactured world.
>
> Or, in this case, non-human life in a completely fabricated, technological, and infrastructural world.

The caverns were excavated more than a hundred meters below ground in the Jurong Formation, a sedimentary geology of sandstone, siltstone, mudstone, shale, tuff, and conglomerate rocks formed from the late Triassic Period to the early Jurassic (between one and two hundred million years ago) and extensively folded and faulted by tectonic forces. The Jurong Formation is composed of the western third of the island of Singapore and adjoining undersea areas.

The first feasibility studies for the construction of underground rock caverns in Singapore were undertaken in the early 1990s, with a view to developing such spaces to house a variety of programs "ranging from industrial to recreational, such as hydrocarbon storage, warehouse and logistics, data centre, energy production, incineration plant, factory and workshop, sewage and water treatment, water storage and storm water retention, sport complex, library and learning complex, R&D laboratory, transport station and depot" (Lui, Zhao, and Zhou 2013, 8).

Underground space research has become its own distinct branch of science, engineering, and urban planning in Singapore. Nanyang Technological University has a Centre for Underground Space. Singapore's Urban Redevelopment Authority is developing a masterplan for underground spaces (URA, n.d.). As part of this process, it is creating a three-dimensional map of underground spaces and infrastructure in Singapore.

This turn to the underground is unsurprising, given that land-use planning in Singapore is a brutal calculus. In the 2013 Land Use Plan, the Ministry of

National Development predicted that Singapore's land-use requirements in 2030 would be 76,600 hectares. At the time, Singapore had 71,400 hectares, a shortfall of 5,200 hectares (Singapore Ministry of National Development 2013). There are two strategies for making up the shortfall: continued reclamation, and intensifying the use of existing land. In these circumstances, underground cavern development is seen as freeing up more land for renewed development above the surface.

Singapore's geotechnical engineers have developed highly efficient methodologies for rapidly making feasibility assessments. The quality of subsurface rock masses in terms of their suitability for rock cavern development is rated according to a valuation that assesses a potential site for various jointing properties in the rock mass, water pressure, and leakage. These factors makes it possible to immediately estimate the cost of cavern extraction and structural support (Zhao et al. 1999).

The basic construction of the Jurong Rock Caverns involves five-meter-long rock bolts that act as support systems, with the excavated interior lined with eighty millimeters of sprayed concrete, also known as shotcrete (Winn, Ng, and Wong 2017, 1045). This system defines the statics of the structure, but just as significant is the parallel infrastructure of water-curtain pipes that runs adjacent to the storage caverns and constantly injects water vertically and horizontally into the surrounding rock. The hydraulic potential of water in the surrounding rock mass is all that keeps the product in the caverns (Winn, Ng, and Wong 2017, 1041).

The process of constructing storage tanks underground was 30 percent more expensive than equivalent aboveground construction, as the proponents of the project were quick to note, but the higher added value of facilities constructed on the freed-up land above was more than enough to compensate for this. The rhetorical exhortation for Singapore to keep climbing up the economic value chain, and to read this both symbolically and materially, seems irresistible to the representatives of the Singaporean state. In his speech marking their opening, Lee (2014) made explicit that the symbolic dimensions of the Jurong Rock Caverns were as relevant as the material ones: "More broadly, the JRC demonstrates that we must constantly think out of the box, be bold in tackling our challenges, be tenacious in execution in order to create new space for ourselves whether it is physical space, whether it is space which is metaphorical, thinking space, international space, and development space. It is not just that the sky is the limit, but there are also fewer limits than we think to the depths to which we can go because we are limited only by our own imagination!"

These possibilities are also framed as opening up further space, both literal and conceptual, for continued spatial and urban planning transformations of Singapore: "JTC is exploring building an underground science city, an underground

warehousing and logistics facility, potential underground caverns near the CleanTech Park. Not every project investigated will turn out to be feasible or commercially viable, but we will explore many. And our plans, some will come true, and they will demonstrate the exciting possibilities which we can realize" (Lee 2014).

Here, the Jurong Rock Caverns are invoked as a model for other spatial transformations that may unlock the next phase of Singapore's urban and economic development. This Singaporean underground imaginary has also been taken as inspiration for other regional speculations about the possibilities of underground space. In Hong Kong, in particular, multiple proposals are being studied for burying infrastructure and services in rock caverns underground, based on the Singaporean model (Wallace and Ng 2016).

The formations created by Jurong Island and the Jurong Rock Caverns do not just assemble oil, capital, and space into a single artificial landscape (or, perhaps, an antilandscape, in the case of the underground caverns): they also work biopolitically to reorganize bodies and labor, and quite consciously so. The speeches given to commemorate various phases in Jurong Island's development provide insights into the ways in which Singapore's developmental state constructs its subjects. The state uses a strategy of intensification—not just of land, sea, and the underground, but also of human subjects: "Today, on Jurong Island, nine out of ten workers are technically trained. Half of them have tertiary education. The value added per worker is very high. At over [SGD] 650,000 [about USD 400,000], it is more than eight times the national manufacturing average. These workers must constantly upgrade their capability to keep up with developments in the chemical industry" (Goh 2000).

The drive to create multiplier effects applies not just to the intensity of land use (releasing the surface of Jurong Island from use as storage for more value-added activities), but also to the use to which human capital can be applied. There is a direct parallel between the engineering of the ground and underground, and the desire to create more value-added workers. This is in keeping with Singapore's broader goals, as expressed by the government's Economic Strategies Committee, which include the wholesale drive to increase value added per worker across every sector of the economy (Singapore Ministry of Finance 2010). The workers of Jurong Island are double geological agents: Their capacity to move up the value chain is predicated on their capacity to exploit the underlying geology of the Jurong formation and free up more surface land for higher-value activities. At the same time, their capacity to add value to themselves, as economic actors, depends on their ability to manipulate another geological source material (the oil being shipped from distant geological strata), to which they then apply the most technically advanced and

lucrative transformations in hydrocarbon chemistry. Geologies both near and far are altered by the intricacies of the global petrochemical economy.

Conclusion: Down to a Lifeless Ocean and a Sunless Sea

The history of Singapore is the history of an island and then a city, as well as of a society sitting astride international maritime trade routes. For the past several centuries, these routes have been shaped by European colonial and then Western-dominated international projects that have been central to the development of modern Singapore. Along with the international flows of materials and power, cultural imaginaries of landscapes and peoples circulated and were appropriated, misappropriated, and incorporated into new cultural formations.

One such expression of the British colonial imaginary of landscapes of the East is found in Samuel Taylor Coleridge's Romantic Orientalist fantasy "Kubla Khan," a poetic reverie imagining the summer palace of the fabled emperor, famously written under the influence of opium.[9] Coleridge's fantasy, however, had roots in historical geopolitical events. Nahoko Miyamoto Alvey (2009) shows how the poem's landscape descriptions can be traced to the travelogues recording the 1793 British mission to Emperor Qianlong, led by Lord Macartney.[10] Macartney was charged with negotiating a loosening of the restrictive Canton System to permit freer trade by the British, as well as showcasing the marvels of English science and technology. He came away largely empty-handed, but his diplomatic efforts were soon replaced by Britain's opium-driven strategy to reverse its astronomical trade deficits with China—a strategy that ultimately paved the way for the colonization of Singapore, a strategic node in British imperial trade networks in Asia.

Coleridge's "Kubla Khan" is thus not just a drug-fueled Orientalist imagining of the grandeurs of Eastern "despotism." It is also a kind of map of the ways in which British imperialism would seek to capture the riches of the East, while simultaneously constructing its cultural relationship to its colonial subjects. Contemporary Singaporean cultural identity continues to involve a layering of precolonial, colonial, and postcolonial readings of human-landscape relations (Koh 1984), a fact made evident in the ways in which Singapore's officials continue to code the cultural and discursive dimensions of the territory's large-scale infrastructure projects.

Opium was also deeply implicated in the development of colonial Singapore's trade economy: calculations of Singapore's exports to China in the second half of the nineteenth century frequently list opium as the leading commodity traded (J. Lim 2012). It has become common to refer to modern capitalism's and the global

economy's addiction to oil. Like opium in the eighteenth and nineteenth centuries, oil shapes complex assemblies, including geopolitical formations, economic and financial circulations, territories of production, and everyday lives. In "Kubla Khan," Coleridge imagined the fabled ruler's efforts to construct an earthly paradise. But instead of the life- and immortality-giving river of Eden, the sacred River Alph flows into an underground world, with its "lifeless ocean" and its "sunless sea" (Coleridge 1987, 88–89). These images of the Romantic sublime have taken on a new resonance in the Anthropocene, with predictions of mass extinctions of maritime life or atmospheric haze over Southeast Asia from Indonesian forest fires.

Singapore's Jurong Rock Caverns are more than just an example of geotechnically engineered infrastructure. The histories of international trade and its related technical infrastructures; of the expansion and reconfiguration of cities and landscapes; of cultural readings of the productive, environmental, and aesthetic value (or absence of value) of territories both above and below the earth's surface; of the manipulations of human subjects and subjectivities—these are all chains of interlocking and unfathomable complexity that shape our contemporary carbon-based existence. Scholars are increasingly trying to trace small parts of such associations, which often seem strange or discontinuous to us at first. That something as mundane as Singapore's decision to build a large underground storage facility for liquid hydrocarbons might also begin to unlock narratives about diverse trajectories of people, ideas, and things should no longer come as a great surprise. On this more associative plane, the caverns are far from lifeless. Although they might literally contain the chemical remnants of marine life that died eons ago, they are also endlessly lively spaces that carry the compounds of economic processes, national discourse, landscape values, technical knowledge, artistic imaginaries, and much else besides.

Notes

1. Singapore ranks eleventh in the world in the United Nations Human Development Index (UNDP n.d.).

2. In a speech marking the opening of the Jurong Island Road Link, Lee Hsien Loong (2000, 2), then the deputy prime minister of Singapore, observed: "But the world does not stand still. Our approach to create the industry complex has borne fruit, and given us a precious lead. . . . Others will emulate what we have done, and learn from our mistakes. So we must continue to build on what we have done, and strive to climb higher still."

3. A 1989 book on the Singapore petroleum industry was titled *Houston of Asia* (Doshi 1989).

4. The shifting alliances between Srivijayan leaders and the Malay Orang Laut ("sea people") created circumstances that have alternately been described as duties or piracy, depending on whether the Orang Laut were operating within or outside the auspices of the Srivijayan Empire (Abshire 2011, 13–25).

5. See Chua, Low, and Gouw-Iwata 2003; Singapore Ministry of National Development 2013; Lui, Zhao, and Zhou 2013.

6. Oriental shells were fashionable in late Regency and early Victorian interior decoration. This curious history has had an outsized legacy in the language of the global oil industry, leading M. Samuel and Company, Limited to adopt the name Shell when it spun off its oil business in 1897 (Shell Global, n.d.). The *Murex*, named for a tropical sea snail, was the first oil tanker to sail through the Suez Canal in 1892. Samuel had had it built to the Suez Canal Company's precise specifications to ensure that it would be permitted to travel through the canal while maximizing its load (Elliott, Alan R. 2008. "Marcus Samuel's Oil Excursion." *Investor's Business Daily*. 23 April 2008). The first shipment of kerosene received by the Singapore depot in 1892 was delivered by the *Murex* (*Singapore Free Press and Mercantile Advertiser* 1892).

7. The depot was actually built by Syme and Company, a Singapore trading house that M. Samuel and Company, Limited appointed as its local agent (Moey 1991, 27–28).

8. See Tay et al. 2018.

9. Coleridge writes in his preface of taking "two grains . . . to check a dysentry [*sic*]," rather than admitting to the opium addiction with which he periodically struggled (quoted in Hayter 1968, 28).

10. Alvey's study is an extension of the new historicist analyses of the poem by Leask (1998) and Kitson (2007, 143–213).

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CHAPTER THREE

A Floating Power Plant

Provisional Energy Infrastructure and Afro-Asian Connections

GÖKÇE GÜNEL

In addressing urgent electricity demands, many countries in the Global South are looking toward quick power generation systems. One emerging system is powerships: floating power plants that anchor in a harbor, plug into a national grid, and generate electricity with heavy fuel oil or natural gas.

The Turkish company Karadeniz Holding—or Karpower, as it is known to many of its customers—has become an increasingly prominent producer of powerships in the past decade. A family-owned business, Karpower builds the ships on spec in various shipyards in Istanbul and leases them to places with high energy demands. Its barge, *Ayşegül Sultan*, anchored in the Tema Fishing Harbor in Ghana and produced power for the country's grid between December 2015 and September 2017, initiating the company's operations in Africa (figure 3.1).[1] At a time when Ghana's electricity production capacity amounted to about 2,500 megawatts in total, the barge produced 235 megawatts of power, constituting about 10 percent of Ghana's electricity.[2] The larger powership *Osman Khan* replaced *Ayşegül Sultan* in late 2017, providing 450 megawatts and thus almost doubling Karpower's production volume. In an effort to switch its fuel source from heavy fuel oil to natural gas (a less expensive and more environmentally friendly fuel), *Osman Khan* moved in late 2019 from Tema to Takoradi, a port much closer to Ghana's natural gas reservoirs.

Powerships illustrate a shift from what energy companies have called permanent power to temporary power, although this binary admittedly does not reflect the complexities of the transformation. A 2014 article in *POWER,* the go-to trade periodical that has been published in North America since 1882, asked: "When 'temporary power' supplies nearly a quarter of a grid's demand, is it still temporary power? How about when a project lasts 10 years?" The article continued: "Calling power service temporary doesn't quite capture all of its distinguishing attributes. It's temporary rather than permanent, rented rather than owned, and mobile rather than fixed. It's also modular and easily scalable" (Reitenbach 2014). Others in the industry have argued that temporary power stations are compelling due to their low up-front capital requirements and rapid installation.

Figure 3.1. *Ayşegül Sultan* moored at Ghana's Tema fishing harbor. (Photograph by Gökçe Günel.)

While the shift from permanent power to temporary power flattens some aspects of power generation, it still signals scalar transformations for producers and consumers of energy, challenging existing categories of spatial and temporal relations to achieve particular political and economic ends. As pragmatic projects, powerships seek to institutionalize this seemingly novel way of seeing energy production and consumption, bringing forth a scalar perspective that does not necessarily reflect the social and political ideals of lessee countries, but that might for a liminal period provide infrastructural relief.

Drawing on fieldwork in Turkey and Ghana between 2016 and 2020, this chapter analyzes the operations of the Karpower floating power plant in Ghana and makes three main points.[3] First, it argues that temporary power structures such as the powership capitalize on the potential for long-term development and linear progress in the places where they are put to use. Their producers frame them as liminal devices whose presence demarcates a phase of planning and incubation, and whose eventual demise will engender a new era of modernization. In Ghana, the provisional status of the powership denoted a period of transition, to be followed by various kinds of renewable energy infrastructure. Decision-makers in Ghana—

such as members of the Energy Commission, executives at solar power companies such as Beijing Xiaocheng Company and Meinergy, and green finance professionals at banks such as Cal Bank or Stanbic Bank—employed a range of technological models and business solutions to precipitate that new era (Günel 2021).

Second, the chapter shows how temporary power producers are financially and politically invested in extending and prolonging the liminal period they generate as far into the future as possible, absorbing the country's resources and suspending the arrival of an age beyond their obsolescence. In early 2020, even when Ghana no longer suffered from electricity shortages and no longer needed temporary power from a floating power plant, the powership continued to produce electricity there. "We can extend this 10-year deal by another 10 years. We can even sell electricity to neighboring countries through Ghana," one executive with the company said about the initial phase of its Ghana operations (quoted in Ergin 2014). Despite ambiguities regarding how long the powership would remain, development goals for the period beyond the ship's use remained intact.

Third, the chapter argues that the seemingly simple, makeshift qualities of temporary power infrastructure such as floating power plants are made possible by close and long-term geopolitical and geoeconomic connections (in this case, between Turkey and various countries in Africa). Turkish foreign investment in Africa has grown over the past decade, due mainly to the country's interest in diversifying away from the Middle East, as well as an attempt to influence Africa's large Muslim population at a time when Turkey's European Union integration has stalled (Baird 2016; Güner 2020; Langan 2017; Shinn 2015). Turkish investment in Ghana's energy sector followed closely behind the arrival of services provided by Turkish Airlines, which has direct flights and cargo services from Istanbul to more than fifty cities across Africa. Since 2002, Turkey has also expanded its governmental presence in Africa, and it currently has embassies in forty-four countries.

On a discursive level, the anti-Western propaganda of Recep Tayyip Erdoğan, Turkey's president, has found supporters in Africa. In addressing African audiences, Erdoğan falls back on Turkey's Ottoman roots, tells his listeners that Ottomans never colonized Africa or enslaved its peoples, criticizes the development strategies implemented by the International Monetary Fund and the World Bank across the continent, and overall seeks to offer an alternative to the West.[4] In doing so, he attempts to practice what the historian Ayşe Çavdar (2013) labels "imperialism by anti-imperialists." Beyond just supporting a belief in the possibility of advancement to clean energy use, powerships invoke a potential for linear development by facilitating relationships between Turkey and Africa.

Potential for Progress

Powerships promise temporary power, constituting contingent networks that meet the basic electricity needs of a society for a predetermined amount of time. In a context where various forms of temporary power are gaining popularity, powerships differentiate themselves from competitors through their formal qualities—namely, by being capable of moving from sites of production to sites of consumption using a seascape, and thus being relatively independent of logistics networks.[5] Unlike other systems of power generation, the construction of powerships is undertaken in a completely different environment than the one in which the floating plant will function. By centralizing production in shipyards in Istanbul, Karpower controls its operations efficiently.

Powerships do not require large swaths of land, making the projects especially desirable for lessees.[6] Once a powership arrives at a harbor, the only supplement it needs is high-frequency cables that connect it to the nearest substation. At Tema in Ghana, for instance, this substation was nine kilometers away (figure 3.2). Finally, since their only connection to the land is through these high-frequency cables, powerships seem more tenuous than land-based plants, giving the appearance that the ship could leave at any time—especially if and when their presence in lessee countries no longer makes financial or political sense.[7]

As a temporary and market-based system, powerships do not offer teleological narratives about progress. In contrast, the historian Stephan Miescher (2014, 341) shows how Ghana's Akosombo Dam hydroelectric power station (also known as the Volta Dam) "produced different temporalities of an industrialized future that would transform the country's rural past and create new cities, factories, and infrastructures during the 1950s and 1960s." At the dam's inauguration ceremony in January 1966, Kwame Nkrumah (the first president of independent Ghana and a pan-African statesman) announced: "It is in this spirit of fruitful collaboration for a better world for all that I . . . inaugurate the Volta River Project. Let us dedicate it to Africa's progress and prosperity. Only in this way will Africa play its full part in the achievement of world peace and for the advancement of the happiness of mankind" (quoted in Ayensu 2013, 19). Nkrumah was overthrown by a military coup a few months after this ceremony. "The future envisioned by Nkrumah, in which each would give according to his ability and receive according to his needs," as the literary scholar and cultural historian Saidiya Hartman (2007, 177) observed, "had been eclipsed."

In the decades following the coup, inadequate rainfall and rising temperatures associated with climate change have negatively impacted Akosombo (Silver 2015; Yarrow 2017). As power demand increases across Ghana, the dam is no longer able

Figure 3.2. Tema fishing harbor, twenty-five kilometers east of Accra, Ghana. (Photograph by Gökçe Günel.)

to meet national electricity needs. While modernization through technology and investment in centralized infrastructure seemed plausible in the 1960s, these ideas have increasingly lost credibility and relevance (Ferguson 1999; De Boeck 2011; Simone 2004). Despite connotations of progress, stability, and permanence, infrastructure projects often embody such oscillations (Carse 2014; Anand, Gupta, and Appel 2018) and increasingly confront environmental challenges borne from climate change.

Yet the powership's temporary presence in Ghana signifies a prolonged period of liminality (a state of in-betweenness with particular temporal and spatial qualities) that could eventually lead to a renewable energy future. According to Serkan, the director of Karpower's Ghana office since 2016, "While they rely on powerships, countries like Ghana could invest in renewables."[8] He echoed a common opinion, seeing temporary power systems as interim solutions enabling Ghana to leapfrog to renewable energy infrastructure such as rooftop solar panels and small on-the-grid power stations (Pinkus 2016; Weszkalnys 2015; Günel 2019). Serkan's

comment implies that temporary power has made planning for the future possible, which in some ways makes up for what the anthropologist Brenda Chalfin (2014, 93) describes as "an incapacitated developmental state."

Fikri, a mechanical engineer in his late forties with a strong interest in nautical design, collaborated with a small team to plan and build the initial floating power plants in 2008 and 2009. In March 2018, as we circuited the Sedef Shipyard—the largest private shipyard in Turkey, situated among forty others in the Tuzla neighborhood of Istanbul—he told me about these first ships. "Between 2000 and 2005, everyone was building ships here in Tuzla. There was such a boom that design units couldn't handle production," he recalled. "But then the 2008 crisis hit, and the shipping industry still hasn't recovered from that shock."[9]

Karpower executives saw the 2008 financial crisis as an opportunity, and started purchasing large ships from owners around the world at low prices.[10] The company already had a wide variety of investments in the energy sector, which was a flourishing industry during the privatization of Turkish electricity markets in the early 2000s. It had also been providing power to Iraq for some time through a land-based plant. After the financial crisis, company executives wondered if it would be possible to place electricity production facilities on a ship that would anchor at Iraq's Basra harbor. Refurbishing inexpensive ships as floating power plants would be a marketable solution for countries with affordable fuel, crumbling infrastructure, and access to rivers or an ocean. However, if the countries where Karpower worked stopped compensating it for its services, then the powerships would simply leave. This business plan would work especially well in places like Africa, where it was difficult to receive financing for permanent, large-scale energy projects.[11]

Complete with tall and orderly exhaust stacks whose gleam can be seen far away, powerships combine elements of thermal power plants with those of large ships. Moored in ports deeper than five meters, the ships look sturdy, substantial, and functional. Fatma, a third-generation board member who represents the company's stakes abroad and in the media, emphasized to me that powerships are not high-tech items: Their use "is not rocket science," she said. Fatma has a degree in economics and philosophy from a college in upstate New York, and we met through a friend who had studied with her there. Her maternal grandfather started Karadeniz Holding Company in the late 1940s, and the company had done well over the years. However, it had never before garnered the attention it was receiving due to its powerships. Fatma regularly gives interviews to newspapers about powerships, and she is adept at talking about them with various stakeholders. According to Fatma, powerships basically consist of multiple engines that burn heavy fuel oil or natural gas. She reiterated to me that this was old technology, which has not

changed much for the past hundred years. Rather than building these power stations on land, Karpower simply chooses to place them on used ships, rendering them more mobile and easier to manufacture.

Thus, the producers of powerships argue that they enable a state of liminality, a brief pause in which Ghanaian and other authorities are able to make plans for a future fueled by renewable energy. Representatives from the Electricity Company of Ghana, Ghana Environmental Protection Agency, and Ghana Grid Company (GridCo) support this imagination of a renewable energy future. "Have you seen the solar map of Ghana?," Raymond, a legal advisor to GridCo, asked me enthusiastically during a meeting in July 2018. "We are missing opportunities by not building solar here." While powerships remain in use, such infrastructure could be built incrementally, but these projects are often deferred (Ahmann 2018).

Liminal Devices

Powerships postpone progress toward an era that would commence only upon their departure. Temporary energy infrastructure such as powerships generates electricity for the grid on a day-to-day basis, and it pragmatically addresses routine consumer demand until it can eventually be replaced by clean and sustainable energy generation. Salih, a Turkish ship engineer in Ghana, defines temporary power infrastructure as "short-lived (*ömürlü*) items." According to him, manufacturers specify a life span for such items: "In terms of time, a thousand hours for example, or usage, a hundred thousand miles for example." He believes that hydrogen energy will eventually satisfy global energy demand, and he hopes that it will also supply Ghana's needs in an abstract future beyond the era of powerships. As an employee of a thermal power plant, Salih understands temporary power infrastructure as a stop-gap solution, which eventually needs to be replaced by a substitute.

As businesses that operate according to market logic, temporary power producers are financially and politically invested in extending this in-between period as far into the future as possible, thus suspending their obsolescence indefinitely. In Ghana, powerships helped alleviate the persistent power outages that Ghanaians had christened *dumsor*, meaning "off and on." During the final *dumsor* period between 2012 and 2015, power for industries and homes would routinely be out for twenty-four hours, and then turned back on for only twelve hours (Ahlijah 2017). The electricity crisis prompted protests against the incumbent National Democratic Congress government, earning John Mahama, then president of Ghana, the nickname "Mr. Dumsor." Its impacts on daily life were publicized in major media outlets around the world, putting Ghana's position as a lower-middle-income country at risk. Forced to diversify the country's energy portfolio, Ghanaian

decision-makers (officials at the Ministry of Energy, the Volta River Authority, the Electricity Company of Ghana, and GridCo) initially imported diesel generators. They later switched to power stations operated by heavy fuel oil, a much less expensive resource than diesel, and eventually to leasing a powership.

In explaining their success in ending *dumsor*, Kartal, a senior member of Karpower's board, told me that discussions on energy tend to be fixated on the future, proposing solutions for forthcoming problems associated with climate change and impending energy scarcity, rather than focusing on significant issues that impact many people around the world in the present. For him, the crucial question was how to turn the lights on today: "What *now*," he concluded in English. As we spoke, Kartal played with a silver bracelet he wore that had a stamped inscription: "ELECTRIC MAN."

"It takes four years plus to build a conventional power plant," Joseph, an operational director at GridCo told me during a meeting in his office in July 2018, "so the arrival of the ship has been key" to ending *dumsor*. By putting an end to the electricity crisis, the powerships filled up the near future with productive activity. However, complying with the logic of the market, the executives who run the powerships wish to move that near future as far as possible.

It is important to note that the powership did not leave even when it was no longer necessary for ensuring Ghana's energy supply, demonstrating that long-term political, financial, and contractual relations at times outstrip practical necessities. Representatives of the Energy Commission, the Electricity Company of Ghana, and GridCo emphasize that the government had had limited bargaining power when the powership first arrived, since they were navigating an ongoing electricity crisis. Therefore, they had agreed to pay high prices, hoping to renegotiate them later. Beyond obtaining emergency power from the floating power plant, the Electricity Company of Ghana signed forty-three power purchase agreements with various vendors during *dumsor*, altering Ghana's energy production portfolio significantly for years to come (figure 3.3). Independent power producers from countries such as China and the United Arab Emirates began generating electricity, mainly in power stations in Tema and Takoradi. One energy professional who had been a junior member of a team at the Energy Commission reflected back on the crisis in an interview with me in early 2020: "We oversolved the problem." In 2020, five years after the end of *dumsor*, Ghana had an excess of electricity on its grid.

In seeking to explain how Ghana's energy portfolio radically shifted from a condition of scarcity to one of excess, energy professionals in Accra point to power contracts that have not only allowed but also incentivized independent power producers such as Karpower to remain in the country. Many independent power

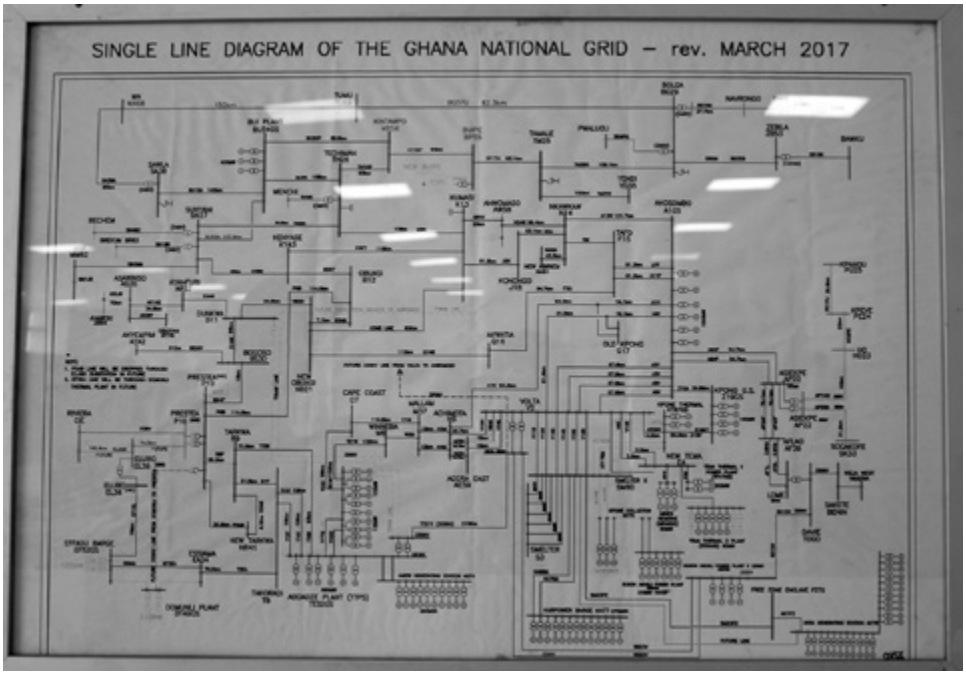

Figure 3.3. Ghana's national electricity grid. (Photograph by Gökçe Günel.)

producers entered the Ghanaian market on take-or-pay contracts, according to which the Electricity Company of Ghana would either buy electricity from a producer or pay that producer a penalty for unused power.[12] As of January 2020, even though peak demand rarely exceeds 2,800 megawatts, the country had an installed power generation capacity of about 5,000 megawatts. According to Chalfin (2014, 106), "the state appears a patchwork of shadows and surfaces, flimsy contracts, false promises, and financial tolls asserted amidst other agencies and authorities, none holding a solid grip on the direction of political life."

"A hungry man does not need a table full of rice," Joseph from GridCo explained during an interview in his Tema office in December 2019. "One plate is enough. Why build 5,000 megawatts when you can't consume it?" Of this total, 2,300 megawatts were being produced on a take-or-pay basis. As a result, Ghana paid over USD 500 million per year for electricity it did not consume, putting a major strain on the country's economy. "The energy sector can sink Ghana's economy," commented a foreign aid worker who has been in charge of electricity projects in the country for the past three years. He celebrated the 11.17 percent tariff

increases that the Public Utilities Regulatory Commission had announced in July 2019, putting pressure on consumers while generating more liquidity for the country. Recognizing the disproportionate burden of electricity on the economy, a midlevel energy executive at a thermal power plant in Tema quipped that the Ghanaian government neglected other infrastructure because it was unable to pay for anything besides power production. He blamed the traffic that paralyzes transport between Accra and Tema on badly negotiated power contracts. The new power producers triggered gridlock that seeps beyond the boundaries of electricity networks, precluding teleological thinking about progress. By remaining on the grid, independent power producers such as powerships inadvertently contribute to the suspension of any visions of future renewable energy development.

A devoted member of one of the leading charismatic churches in West Africa, Joseph from GridCo summarized his relationship to *dumsor* by using an analogy: "Can you kill the devil? The world would be a very beautiful place if you could kill the devil. But you can't kill it. You have to stay away from its control. It's the same with *dumsor*. You can't kill *dumsor*. You can only stay away from it." According to Joseph, power cuts will continue to characterize the Ghanaian grid for years to come. Regardless of the countless complications, he hopes that new power producers will manage to keep the devil away until they are replaced by renewable energy power stations in an abstract future.

Solution Partners

Karpower seeks to construct a sense of familiarity with the countries where it works, as evidenced by its slogan, "The Power of Friendship." Named after family members, the powerships are explicitly presented as visitors to lessee countries. These corporate strategies are supplemented by the ways in which the company's employees approach their counterparts. For instance, Serkan from Karpower told me that Turkey shares many customs with Ghana, such as certain marriage rituals. "Just like us, Ghanaian young men have to ask for their girlfriends' hands by paying a visit to the family," he said. During informal meetings, many Turkish energy professionals I met in Accra and Tema made essentializing remarks regarding Ghanaian people, foregrounding differences between them and Turks. Yet the corporate emphasis on shared customs is designed to focus on the possibility of shaping common developmental trajectories for Turkey and Ghana.

In a 2019 interview with the Turkish newspaper *Hürriyet*, Fatma, the Karpower board member, commented: "Our biggest secret is becoming companions in misfortune with the countries where we provide electricity. The trust we have generated

by being troubled by the troubles of, especially, African countries opens the doors for new projects."[13] A Ghanaian businessman explained that he enjoyed working with companies such as Karpower for precisely this reason: Their employees did not position Turkey as better than Ghana. Rather, they focused on the common problems the countries had experienced on the path toward development. "They are not patronizing or condescending, like American or French companies," he concluded. Given this emphasis on trust and familiarity, Karpower executives define themselves as solution partners—working in collaboration with the countries where they operate, aspiring to solve shared problems—rather than as evasive providers of temporary energy infrastructure who could leave at any time.

This does not mean that relations between Karpower and its counterparts are free from tensions and controversy. In practice, the discourse of familiarity and trust is combined with a particular contractualism, wherein take-or-pay contracts remain in use regardless of how they impact a government's interests. For instance, in examining the Lebanese electricity market where powerships have been producing electricity since June 2012, a World Bank report (ESMAP 2020, 28) suggested, "With hindsight, it would likely have been cheaper to have invested in permanent capacity, rather than keep paying high take-or-pay charges." In their investigative reporting on Karpower, reporters from South Africa's nonprofit news service *AmaBhungane* claimed that when a powership entered a market, it remained there for the entirety of the twenty-year contract, regardless of whether or not it produced electricity for the grid. The reporters highlighted the problems with powership contracts, arguing "it appeared that Karpowership had a practice of entering new markets by paying large facilitation fees to politically exposed persons which could be construed as bribery" (*AmaBhungane* 2021). All in all, the rhetoric of friendship paralleled extractive practices that ensured corporate benefits.

Despite the seemingly elusive nature of powerships, Karpower's operations in Ghana demand long-term multiscalar relations, including those that happen at the level of the nation-state and that are cultivated constantly by company executives (Appel 2012; Chalfin 2010). In other words, the simple makeshift qualities of provisional power infrastructure are made possible by long-term geopolitical and geoeconomic connections between Turkey and Africa. During an official address at the Dakar International Conference Center in March 2018, Erdoğan emphasized: "Depleting Africa's resources and adopting a modern colonial system is not our style."[14] As I have found in interviews I conducted between 2016 and 2020, many members of Turkey's business community debate whether this populist propaganda is actually useful for business. Still, many of them claim that diplomatic trips to Africa have strengthened a sense of commitment to Africa on the part of

Turkish citizens and strengthened the notion that all Turkish companies could become solution partners.

Yet through such populist propaganda, Turkish exports such as floating power plants have been "harnessed to distinct ethical regimes and political projects," as the anthropologist Antina von Schnitzler (2016, 28) puts it in reference to prepaid electric meters. Turkish businesspeople's willingness to suffer together with African countries, their ability to showcase Turkey as a model for overcoming certain developmental challenges, and their desire to propose an alternative to companies from the West allow populist leaders such as Erdoğan to claim an imperial legacy, in both Turkey and Africa.

During conversations with Mauritanian businesspeople interested in working with Turkish companies, I heard over and over again that Erdoğan would win a national election in Mauritania if he wished to become president there. Some Turkish businesspeople hoping to collaborate with companies in Africa joined in the praise. One told me during the diplomatic trip: "Of course, here [in Africa] these men's self-confidence has been crushed for years, which is why it is hard for them to put themselves to work and to do business, it is hard for them to recover. We shared the same predicament, but thanks to Erdoğan we pulled ourselves together again."[15] A Turkish executive from a company that operated successfully all over Africa told me over coffee that Turkish businesspeople were "like monkeys," performing for the government and showcasing Turkey's business capacity. Turkish investments in Africa not only rely on what might be called nonimperialist imperialism, but they also sustain and augment it, and they enhance Erdoğan's popularity back home in Turkey.

Turkish foreign policy in Africa is especially clear in diplomatic trips (figure 3.4). I met Kartal, a senior member of Karpower's board, on one such trip to Senegal in February 2018, and I had stimulating conversations with him over lunches and dinners during four days. The Foreign Economic Relations Board of Turkey had organized this trip, and its press relations team had invited me to join the delegation of about 120 businesspeople and some journalists.[16] Our presence at the Dakar International Conference Center was significant, because Turkish construction companies had developed this building. In Senegal's new city, Diamniadio (under construction nearby, and intended to ease congestion in the seaside capital, Dakar), two Turkish construction companies had collaborated on building an airport after the Saudi Binladin Group had given up on the project. There will be even more large-scale construction projects, given that Macky Sall, the Senegalese president, intends the new city to include a new industrial park and university, and Turkish construction companies hope to beat their French and Chinese counterparts and

Figure 3.4. A Turkish business delegation visits Nouakchott, Mauritania. (Photograph by Gökçe Günel.)

win more contracts. Like these construction companies, power producers such as Karpower and Aksa exemplify Turkey's expansion into African markets, acting as what some have called a soft power mechanism to promote Turkish foreign policy.

Besides partaking in such national strategies, joining diplomatic trips is at times commercially valuable for representatives of Turkish businesses such as Kartal. When two representatives from the Senegalese government approached him outside the large hall where Erdoğan was scheduled to give an address, Kartal kindly asked me to stay and listen to their negotiations. The Senegalese men had heard good things about powerships from their contacts in Ghana, and they knew that the ships were now in use in Gambia and Sierra Leone as well. When a construction company representative from the Turkish delegation told them that Kartal was there at the Dakar International Conference Center and offered to arrange a meeting, they became very interested. They did not know much about electrical infrastructure, but they knew that use of powerships was becoming popular.

Without wasting too much time on pleasantries, the Senegalese representatives told us that they had been talking to some international companies that could provide electricity. They had been offered a rate of eleven cents per kilowatt-hour by these unnamed companies, and they asked if Kartal's company would be able to propose a better rate. But Kartal refrained from engaging with the representatives on their own terms. "Rather than talking about price, let's talk about delivery times," he said. "Our ships can be here in two weeks. Can the other company give you electricity in such a short time?" He proposed leasing *Ayşegül Sultan*, the ship that used to power Ghana's grid, to Senegal. When the men left, he turned to me and said, "Wouldn't it be very convenient if we did not have to move *Ayşegül Sultan* all the way back to Istanbul, and if we could use it in Dakar instead?"

Despite their makeshift qualities, the floating power plants are enmeshed in complex processes, which involve not only geopolitical relations between Turkey and Africa, but also various staff members and executives who make decades-long commitments. Although Kartal was scheduled to return to Istanbul with Erdoğan's delegation that evening, he asked for his suitcase to be retrieved from the plane, and he stayed in Dakar for a second, more comprehensive conversation with the Senegalese government. He always took a photograph of his suitcase with his iPhone, because he often found himself asking flight attendants to remove his luggage from the plane for an urgent meeting. His plans changed constantly. In cultivating closer and stronger relations with his clients, Kartal was always willing to revise his schedule. He believed that this flexibility gave him the upper hand in conducting business in Africa. "It's time for me to buy my own plane, so that I don't deal with this kind of thing," he said. "But once I buy a plane, I will also have to hire bodyguards. The nature of the business will completely transform." Several days later, he sent me a WhatsApp message to say that his conversations with the Senegalese authorities had gone well. There was a good chance that he would lease two ships to them, rather than one. In late 2019, *Ayşegül Sultan* began supplying electricity to Senegal.

Conclusion

Temporary power infrastructure continues to gain considerable prominence around the world. Yet so far, such infrastructure has received little attention from scholars who work on issues at the intersection of energy, climate change, and development. In producing a clearer understanding of how countries bridge the gap between a state of scarcity and electricity-related crisis, and a potential future where renewable energy supplies the grid, it is important to examine how temporary power infrastructure works.

In analyzing a Turkish floating power plant in Ghana, this chapter makes three main points. First, it points out that temporary power infrastructure enables a vision of linear development and future progress, mainly by serving as transitional projects that will eventually be replaced by renewable energy resources. Forms of temporary power infrastructure such as powerships are framed as liminal devices that come with the promise of their own obsolescence. Second, the chapter demonstrates how this liminal and transitional era may be stretched indefinitely to suit a wide range of financial and political interests. Even at a time of energy excess, for instance, the powership remained in Ghana, showing how the profit-making needs of independent power producers and the contractual relations between various decision-makers impact the Ghanaian grid. Still, the sense that a new era of modernization will commence when innovative renewable energy infrastructure replaces such temporary devices remains valid and intact.

Third, the chapter shows that close transnational relations between solution partners invoke developmental trajectories, as Turkish businesspeople and diplomats suggest that a country like Ghana could experience the same stages toward development that Turkey had undergone in the twentieth century. Implementing a certain grammar of capitalist relations that differentiates Turkey from other actors in the region has not only worked to extend Erdoğan's popularity, it has also helped create a context for encounters between Turkish businesspeople and their African counterparts where they make business decisions that foreground their flexibility. An examination of these multiscalar connections illustrates how the tenuous and makeshift qualities of temporary infrastructure belie the social and political relations that catalyze this seascape of power.

Notes

1. Named for a member of the Karadeniz family, *Ayşegül Sultan* had formerly been called *Sainty No 10*, and had been used for transporting components of bridges and offshore plants in the Netherlands. In 2015, Karpower engineers retrofitted the 140-meter-long vessel in the Sedef Shipyard in Tuzla, Istanbul. They worked with this particular shipyard because it was the only one that housed a 300-ton crane strong enough to lift the barge machinery. The new *Ayşegül Sultan* was fitted with twenty-four dual-fuel engines that were purchased directly from their Finnish manufacturer, Wärtsilä.

2. Such percentages are commonly used by decision-makers, but they are not always accurate. Every day, power producers in Ghana offer varying amounts of electricity to the grid, as predicated by a system of order dispatching and administered by the control room at GridCo, the national grid company. I use these percentages to illustrate the powership's impact, but I acknowledge that they are not precise indicators.

3. I conducted interviews with executives and staff members at Karpower in Turkey, Ghana, and Lebanon between 2016 and 2020, as well as with representatives of the Energy

Commission, GridCo, Electricity Company of Ghana, and Ghana Environmental Protection Agency, and representatives from other independent power producers in Ghana such as Aksa, Sunon Asogli, Meinergy, and Beijing Xiaocheng Company. As a US-based Turkish scholar with expertise in energy and climate change issues in diverse contexts, I could communicate with decision-makers using their professional vocabularies, and learn about different modes of electricity production by visiting a range of power stations. In February and March 2018, I also attended a diplomatic trip to Algeria, Senegal, and Mauritania with the Turkish president Recep Tayyip Erdoğan and his entourage. My attendance to the trip was made possible thanks to a press relations representative, who enjoyed the idea of having a female US-based Turkish scholar analyze the work that went into solidifying geopolitical and geoeconomic relations between Turkey and Africa. Complementing my research, this diplomatic trip offered opportunities to discuss floating power plants with businessmen and government representatives during four intensive days.

4. The scholarship on African slavery in the Ottoman Empire demonstrates that Erdoğan's comments regarding slavery are inaccurate (Erdem 1996; Toledano 1998; Walz and Cuno 2010; Zilfi 2010). The Ottoman Empire relied heavily on the labor of enslaved people, mainly from North and East Africa, Eastern Europe, the Balkans, and the Caucasus. Still, his comments differentiate the Ottoman Empire and the Turkish Republic from the West, emphasizing that the Ottomans were not a dominant part of the Atlantic slave trade networks.

5. Other companies besides Karpower (such as Aggreko, APR Energy, Atlas Copco, Energyst, United Rentals, and Symbion) rent out temporary generation equipment to various countries around the world to meet the increasing demand for power. These generators are powered by diesel, heavy fuel oil, and natural gas. None of these companies currently provides a significant portion of Ghana's electricity.

6. For instance, compare Karpower's operations to those of Aggreko, a large temporary power company headquartered in the United Kingdom, which made a proposal to Ghana for a possible 100-megawatt power plant that required twenty-seven acres of land at Esiama for its generators. So far, that project has not been built (*Construction Review Online* 2015).

7. Karpower employees emphasize that powerships can leave if home countries do not compensate them on time or if there is a war. Yet this statement somewhat contradicts Karpower's experience, which shows that it is not always easy for powerships to depart. For instance, when the Pakistani government did not meet its payment obligations and unlawfully detained four ships, a major legal dispute erupted. In August 2017, after four years of controversy, the International Centre for Settlement of Investment Disputes (ICSID) awarded Karpower one of the highest settlements in ICSID's history. On November 4, 2019, Pakistan's Prime Minister Imran Khan tweeted that his government had resolved the dispute through an agreement facilitated by President Erdoğan and saved Pakistan from having to pay the imposed penalty of USD 1.2 billion (Ghumman 2020).

8. All names in the chapter are pseudonyms.

9. Labor practices in Tuzla shipyards since the early 1990s have been controversial, especially given numerous preventable workplace deaths and injuries (Güney 2016).

10. Nicky Gregson and coauthors have written about such translatability of ships in Bangladesh's shipbreaking sites. Their research points to how "the destructive labor of ship breaking on a beach at Sitakunda is shown to create a range of objects and differentiated streams of material which form the basis for secondary manufacturing, craft and retail activities" (Gregson et al. 2010, 847). Although Karpower retrofits ships without breaking them down in the way

that Bangladeshi ship breakers do, it demonstrates this translatability by benefiting from the afterlives of ships in other ways.

11. While many of my interlocutors repeated this perspective, there are empirical exceptions. For instance, Ghana invested heavily in the expansion of the Tema container port. Senegal supported the construction of a new city, Diamniadio. In seeking to understand why certain infrastructure projects might be favored over others, it is important to investigate the kinds of infrastructure financing available to Ghana and other countries where Karpower operates. Overall, the emergence of floating power plants should be contextualized within a changing landscape of infrastructure financing (Zeitz 2019).

12. Energy professionals from various Ghanaian institutions argue that Karpower was more efficient in its power production than other power producers which were responsible for this energy excess. Therefore, they did not consider Karpower to be underperforming in comparison to other power plants that also benefited from take-or-pay contracts.

13. Author's translation. In Turkish, the quote is: "En büyük sırrımız elektrik götürdüğümüz ülkelerin dert ortağı olmak. Özellikle Afrika ülkelerinin dertleriyle dertlenerek oluşturduğumuz güven bize yeni projelerin kapılarını açıyor" (Güler 2019).

14. Author's translation. In Turkish, the quote is: "Afrika'nın kaynaklarını tüketmek ve modern sömürü modellerini benimsemek, bizim için asla söz konusu değildir" Recep Tayyip Erdoğan. Official Address. March, 2018. For a recording of this speech, please see: https://twitter.com/tcbestepe/status/969863732003246081

15. Author's translation. In Turkish, the quote is: "Tabii burada adamların kendine güveni senelerce sarsılmış, ondan iş yapmaları zor, toparlanmaları zor. Biz de öyleydik ama Tayyip Bey sayesinde kendimize geldik."

16. The Foreign Economic Relations Board of Turkey (DEİK), founded in 1986 by Turgut Özal (then Turkey's prime minister) as part of the country's economic liberalization efforts, organizes such events for members of Turkey's business community to expand the country's foreign commercial operations. My companions in the delegation knew that I was an academic at a research university in the United States and that I was studying Turkey's Africa initiative. However, because I was the only woman in the business delegation, my presence attracted attention and led others to assume that I was an administrative assistant at DEİK. The fact that we all traveled together on a private plane, sharing meals and staying at the same hotels, meant that I was able to socialize easily with delegation members. During the trip, I also interacted with some Turkish ministers. I will analyze the details of this trip elsewhere. For an analysis of the Turkish business world, see Buğra and Savaşkan 2014; Buğra 1994.

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PART II

Territory

CHAPTER FOUR

Peripheral Infrastructure

The Electrification of Indonesia's Borderlands

ANTO MOHSIN

On January 23, 2009, electricity from Malaysia finally reached Kaliau, an Indonesian border village in the Sajingan Besar subdistrict in West Kalimantan. The Indonesian government had agreed to purchase electricity from Sarawak Energy Berhad, a nearby utility company in Malaysia, for about 930 rupiah per kilowatt-hour (about nine US cents). This was considerably cheaper than if the Indonesian state-owned PT Perusahaan Listrik Negara (Persero), known as PLN, had supplied electricity, which would have cost 3,000 rupiah per kilowatt-hour (about thirty-two US cents). Representatives of both the Malaysian and Indonesian utility companies and the governor of West Kalimantan attended the cross-border electricity delivery inauguration ceremony on March 15, 2009 (*Fokus* 2009a). Previously, electricity had been available for only twelve hours in the evening and night, but it was now available around the clock. Maria, a Kaliau resident, was ecstatic: "We feel happy now. Electricity can now be enjoyed day and night like in a city" (quoted in Haryo and Syaifullah 2009).

PLN was also pleased with the arrangement. Electricity demands in the West Kalimantan–Sarawak border regions had increased, and PLN could not meet them all. By purchasing electricity from a neighboring country, PLN could reduce the cost of operating two diesel power plants that supplied electricity to Sajingan Besar and to another subdistrict called Badau (Haryo and Syaifullah 2009). In other words, buying Malaysian electricity relieved PLN of its increasingly burdensome obligations to electrify the border villages.

Illuminating a border region using cross-border electricity marked a shift in Indonesia's electrification strategies. For decades the focus had been on electrifying urban and rural areas far from the borderlands, using electricity generated within the country. Following the electrification of Kaliau, the Indonesian government launched several initiatives through PLN to increase the territorial scale of the country's electricity coverage. After decades of neglect, many isolated areas and remote islands—including border regions—began receiving PLN electricity in the second decade of the twenty-first century. In 2014 these endeavors gained extra support from the newly elected president, Joko Widodo, who had

successfully run on a platform that promised to develop Indonesia from the periphery inward.

After the fall of the 1966–1998 New Order regime under President Soeharto, successive Indonesian governments began paying more attention to Indonesia's borderlands.[1] Territorial forfeiture and the perceived threat of further geographical loss animated a change in perspective. One incident that sparked a renewed commitment to Indonesia's periphery was the loss of the long-disputed Sipadan and Ligitan Islands to Malaysia at the International Court of Justice in 2002. Malaysia's claim of effective administration over the islands defeated Indonesia's historical claim, which had been based on an 1891 colonial agreement between the Netherlands and Great Britain (International Court of Justice 2002).

A second pivotal event, also in 2002, was the wide coverage in the Indonesian media of the dire condition of Nipa, a tiny island on the Indonesia-Singapore border that almost disappeared after extensive sand mining had significantly reduced its size (Mendrofa 2015, 46). Singapore had been reclaiming land by importing sand from Nipa and other places for decades. The concern brought about by the Indonesian media coverage had less to do with the loss of Nipa, which was uninhabited, than it did with the loss of a natural marker from which to draw a median line delineating the maritime boundary between the two countries.

Calls continued to be made by the Indonesian media and citizens to stop treating Indonesia's borderlands as the country's *teras belakang* (backyards). A civilian expedition to survey frontier islands in 2008, and its broad media coverage, further raised public awareness. The Indonesian government passed a law in late 2008 regulating how the country should protect and manage its vast territory and borders. In 2010, it created an interagency organization to develop border regions and improve the socioeconomic well-being of the people who live there. The new agency's 2011 Grand Design specified four approaches to reposition the borderlands as Indonesia's *teras depan* (front yards). One of these was to provide electricity to support the construction of other infrastructures—water, telecommunication, markets, and border posts (BNPP 2011, 38). To achieve this objective, the Indonesian government instructed PLN to prioritize the electrification of border regions.

This chapter examines the post–New Order electrification of Indonesia's periphery. It discusses the sociopolitical and legal contexts that facilitated PLN's new electrification strategies. It also argues that the Indonesian government did not just want to light up the country's frontiers; it also used electricity to protect its borders and create a more unified nation. Electrifying Indonesia's borderlands illuminated these regions, facilitated economic growth, and brought the country's periphery into the fold. The arrival of electricity and other supporting infrastructure

helped instill a sense of national belonging among Indonesia's marginal populations. It transformed border spaces and produced what the introduction to this volume refers to as "new hierarchies, levels of interaction, and imaginations of the world." Regions that were once considered remote became a matter of national interest to be protected, developed, and made more explicitly part of the country. Increased news coverage allowed people of the borderlands to showcase their languages and customs to the rest of the country. Other Indonesians, more informed about these people in far-flung places, started to embrace their fellow citizens and made them feel part of the nation. In this sense, electricity helps illuminate, so to speak, the existence of Indonesia's border regions and the people who inhabit them. However, although electrification has brought benefits for many border populations, some citizens still receive insufficient electricity or none at all.

In his reflection on the mutual shaping of infrastructure and modernity, Paul Edwards (2003, 188) makes an instructive observation: the idea of infrastructure as an invisible and smoothly operating sociotechnical system is a "western bias." Akhil Gupta (2015, 564) supports this statement when he writes, "It is a fact that the grid still does not reach many people in the Global South, and that many areas of the world are not connected to a central system of electric power." A decade and a half ago, one could find similar conditions in many parts of Indonesia, especially its frontier regions. The Indonesian government erected electrical infrastructure in the cities first, then slowly expanded it to the countryside. This center bias—spreading electrical infrastructure from the center to the periphery—is understandable. The initial focus of many governments has been to first electrify areas with higher population densities before moving to light up sparsely populated areas. But in Indonesia, the center bias persisted, not just because of the government's priorities and asymmetrical population distribution, but also because of the perception that borderlands were remote and thus unimportant.

Borderlands as a research topic have received much attention from scholars in various disciplines.[2] As one scholar notes, studies of these regions worldwide are instructive since "borders have histories, as peoples do" (Tagliacozzo 2016, 2). Conceptualizing and historicizing borders helps us understand what they mean to state actors and to the people who live there, and how the idea of borders has been changing throughout history. As Eric Tagliacozzo (2016, 17) asserts, "mapping a border means mapping it in its totality—culturally, politically, and especially historically—and not just mapping the number of hilltops and the demographics of contemporary poverty, work, and migration." Drawing on literature in the field of science and technology studies, I would add that we need to map a border technoscientifically as well—in other words, to make legible the science

and technology employed to imagine, delineate, protect, develop, and police borders.

States survey and map territory, install border markings, and hold talks with neighboring countries to establish borders. They construct walls, barbed-wire fences, boundary markers, and roads to delineate boundaries. They fund the military and create other armed organizations such as border patrols and coast guards to protect and police borders. Countries erect border checkpoints and security posts to regulate the flow of people and goods across borders, although illegally trafficked items still manage to slip through.[3] Nations use cross-border technologies such as pipelines, bridges, and power grids to negotiate the buying and selling of commodities across borders. In short, states build peripheral infrastructures in their state-making projects.

In Indonesia's case, building this peripheral infrastructure has been particularly challenging because of the country's archipelagic character. One important feature of electrical infrastructure is that it is a wired system. Unlike a telecommunication system that can harness electromagnetic waves wirelessly, power grids need wires. Whatever technology is used to generate electricity, it needs to be built on site and it requires cables to distribute the current. As a result, extending a power grid from the mainland to nearby islands, installing a power generation and distribution system on remote islands, or stitching local grids on a cluster of islands into a larger grid can be very expensive.

In his seminal work on the history of the electrical infrastructure of three Western cities, Thomas Hughes (1983) introduced the term "reverse salient" to describe any critical problems that hamper the growth of power systems. For Indonesia, a constant reverse salient to developing a countrywide electrical infrastructure has been Indonesia's archipelagic character. However, Hughes explains that a reverse salient provides an opportunity to solve problems and innovate. And since it is helpful to think of infrastructure as "*socio*technical in nature" (Edwards 2003, 188), solving a reverse salient requires more than just technical fixes. Changing a social perception, rethinking a social arrangement, coming up with a new strategy, or enacting a law can fix a reverse salient.

As I explain below, some of these nontechnical solutions were implemented to solve the reverse salient of Indonesia's power system in the periphery. But the paradoxical nature of infrastructure is that "even as infrastructure is generative, it degenerates" (Howe et al. 2016, 548). Even though infrastructural solutions can deliver purported benefits, "they are also ultimately incapable of forever satisfying the tasks they are meant to carry out" (Howe et al. 2016, 553)—that is, infrastructure can break down or become unusable due to lack of maintenance. Despite

attempts to increase the geographical scope of Indonesia's electrical infrastructure, the remoteness of the country's peripheral infrastructure means that it is challenging to maintain. In this sense, the geography of an archipelago poses a constant reverse salient to nationwide electricity coverage. But the country's archipelagic character is not merely a disadvantage: it also provides Indonesia with an unexpected opportunity.

Becoming an Archipelagic State

Situated along the equator, Indonesia consists of a chain of big and small islands that collectively span a distance roughly equal to the width of the contiguous United States, making Indonesia the largest archipelagic country in the world. The islands are so numerous that within Indonesia, several smaller archipelagos form regional or provincial administrative units such as the Aru Islands Regency and the Riau Islands Province. Indonesia shares land and maritime borders with ten countries in the Pacific and Indian Oceans. Ninety-two islands encircling the archipelago mark Indonesia's outermost maritime boundaries.[4] Only thirty-one of those ninety-two islands are populated (Subandono 2013). Imaginary straight lines connecting the outermost points of those islands create the baselines that Indonesia uses to draw its Exclusive Economic Zone (figure 4.1[5]).

When Indonesia declared independence in August 1945, it did not emerge as an archipelagic state as the concept is understood today. At the time, not all the waters within the Indonesian archipelago were considered the country's sovereign territory. The Java Sea and the Makassar Strait, for example, were regarded as international waters by most foreign nations. It took a unilateral declaration, followed by long and arduous diplomacy, for Indonesia to become a recognized archipelagic state.

In December 1957 Prime Minister Djuanda Kartawidjaja declared that all waters within Indonesia's outermost perimeter would become part of its sovereign territory and control. The so-called Djuanda Declaration turned what had been deemed international waters into lawful Indonesian regions by fiat. This announcement angered many nations, and Indonesia's claim initially met with strong resistance. But Indonesia's persistence, together with the efforts of a few other island nations, paid off seven years later. After a breakthrough at the 1975 Geneva Law of the Sea conference, the United Nations finally acknowledged and adopted the concept of an archipelagic doctrine, which is the idea that an archipelagic nation should be treated as a single sovereign unit. In 1982, the international body passed the United Nations Convention on the Law of the Sea, which

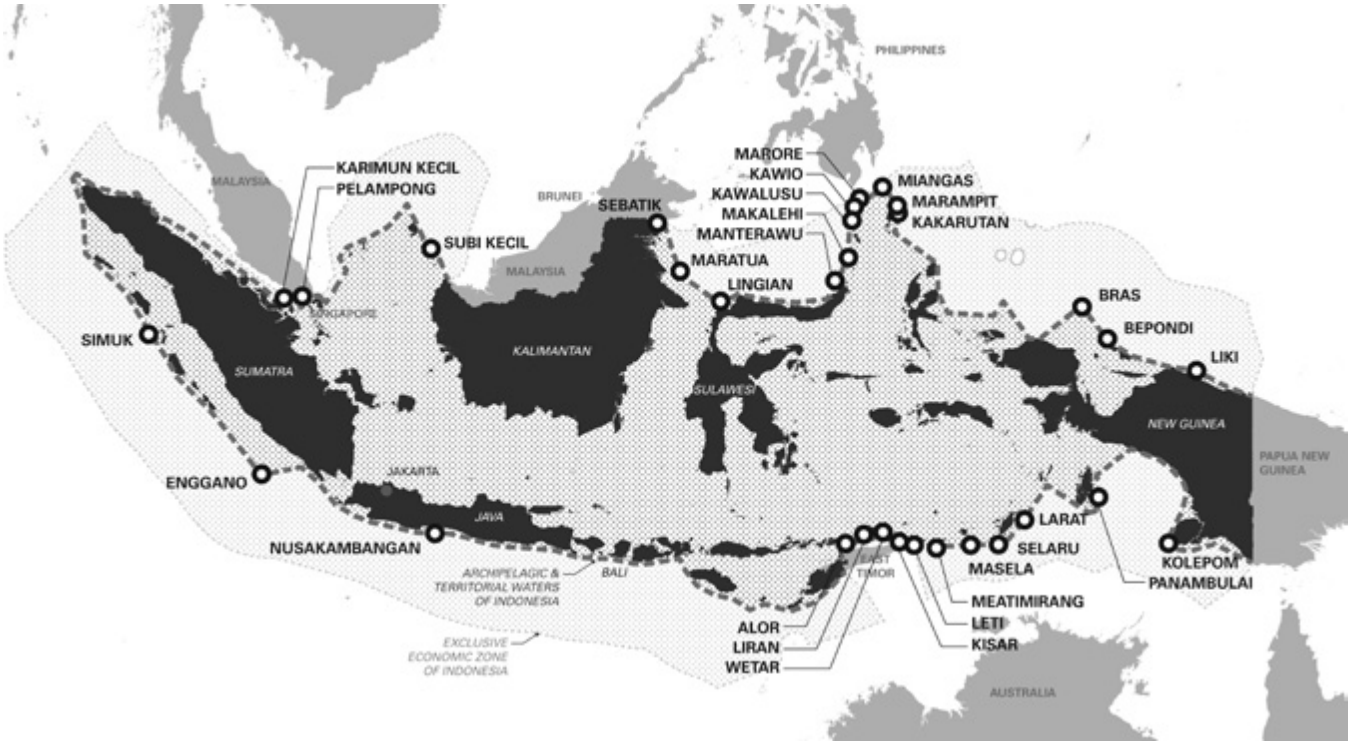

Figure 4.1. Indonesia's thirty-one inhabited frontier islands. (Map by Dorothy Tang.)

endowed a new type of nation called an archipelagic state with full sovereignty over its interior waters. Indonesia ratified the agreement in 1985 (Butcher and Elson 2017).

Even before the ratification, the New Order regime had enacted Law No. 5 of 1983 on the Indonesian Exclusive Economic Zone to exploit the country's marine resources, especially natural gas and oil. The export of these fossil fuels would add to the regime's coffers. The government subsequently allocated bigger portions of the state budget to fund many infrastructure projects across the country. However, most of them were built in Java or in a few other urban centers. Infrastructure projects in the periphery were very few and far between. Nationally, the border regions did not count much in domestic politics because of the small number of people living there. Internationally, they also mattered little, as the regime did not think that these areas played an essential role in regional geopolitics.[6]

Instead, the New Order government was inclined to build infrastructure on other islands, such as Bali and Batam. The Soeharto government developed Bali as a tourist destination and a setting for regional and international meetings—showcasing the results of various projects, including electrical infrastructure (Mohsin 2017a). Batam, an island near Singapore, was specifically developed to rival the neighboring city-state. It is therefore no coincidence that the electrical infrastructure on these two islands is some of the most developed in Indonesia.

A New Perspective on Border Islands

When the New Order regime collapsed in 1998, following the 1997 Asian financial crisis and subsequent student-led protests, the succeeding Indonesian government took a different approach to governing the country. The fall of Soeharto ushered in a new period called the Reformation Era. During this time Indonesia amended its 1945 Constitution, decentralized power by giving more autonomy to districts and provinces, held regular elections for public offices, permitted multiple parties to participate in the elections, increased freedom of the press, and changed the presidential electoral process from having members of the legislature select the president to allowing every citizen to vote directly for president. It was during the Reformation Era that national awareness about Indonesia's border regions gained traction.

For example, the abovementioned critical coverage in the Indonesian media about the island of Nipa jolted the government into action. In 2004 it banned the mining and exporting of sand, began reclaiming Nipa's coastal areas, planted protective vegetation there, and eventually built tetrapod breakwaters to prevent the erosion of the island's coast. President Megawati Sukarnoputri visited the island

and signed her name on a stone monument affirming that Nipa was part of Indonesia. She even left her footprint to be added as part of the monument (Mendrofa 2015, 41). After the government had sufficiently reclaimed the island, it installed two rainwater catchment tanks and a combination solar and wind power plant to supply water and electricity to a newly constructed navy security post (Mendrofa 2015, 42–43).

Several citizens also continued to raise public awareness and shape public perception of Indonesia's frontier islands. Susanto Zuhdi, a noted maritime scholar, had suggested changing the term for them from "outermost islands" (*pulau-pulau terluar*) to "frontier islands" (*pulau-pulau terdepan*) in a speech in 2006 at the Faculty of Humanities of the University of Indonesia. His idea gained support from Benny H. Hoed, then chair of the Association of Indonesian Translators. Hoed contended that the suggested new term—or the similar term "border islands" (*pulau-pulau perbatasan*)—would signal to the people on those islands that they were an essential part of the nation (Iskandar 2015).

Then came a civilian maritime expedition that helped raise public awareness of the frontier islands even more. In May 2008 members of Wanadri (an association of Indonesian explorers) and Rumah Nusantara (a cultural organization) set out on a journey to survey all of Indonesia's frontier islands. Dividing their expedition into three stages, which they completed in a little over two years, the team documented the geophysical dimensions of the islands and the sociocultural aspects of their inhabitants.[7] Significantly, in naming their voyage the Nusantara Frontiers Expedition (*Ekspedisi Garis Depan Nusantara*), the team used part of Zuhdi's term. This indirectly criticized the government, which had been using the older phrase "outermost islands," connoting remoteness and neglect.[8] The expedition called attention to border islands and their populations as significant components of the geo-body of the nation (Winichakul 1994).[9]

Around the same time that national discourse about the country's frontier islands was increasing, the government passed two laws asserting its authority over those areas. The first was Law No. 27 of 2007, regarding the management of coastal regions and small islands. This law's purpose was to manage Indonesia's small islands (those smaller than two thousand square kilometers) and their coasts to preserve them from environmental degradation and the negative impact of human activities. This law was less about developing these islands than about conserving their ecosystems. The second law was Law No. 43 of 2008, concerning the so-called Indonesian Territory, which provided the legal basis for comprehensive management of this territory—especially its border regions. The law stipulates that tampering with the country's boundary marks in any way is a criminal act and any person found guilty of such tampering will be punished. This law elevated

what had previously been considered mundane objects to the status of national importance.

In addition, the government passed Government Regulation No. 62 of 2010 on the uses of small islands in the outlying regions. The regulation explicitly classifies these small islands as part of the so-called Specific National Strategic Areas (*Kawasan Strategis Nasional Tertentu*)—that is, areas of national significance—thus underscoring the rising national desire to treat Indonesia's border islands as front-and-center regions. Also in 2010, the government solidified its commitment to managing its frontier islands and other border regions by creating the National Agency for Border Management (*Badan Nasional Pengelola Perbatasan*, *BNPP*) in order to coordinate border development activities of the central and provincial governments. The agency's board is chaired by the interior minister and includes the heads of eighteen other government ministries and cabinet-level bodies, as well as thirteen provincial governors whose jurisdictions border neighboring countries.[10] The agency's 2011 Grand Design aimed to create border regions that are safe, orderly, and developed, combining security, prosperity, and environmental approaches (BNPP 2011). PLN carried out its new electrification strategies within these broader sociopolitical and legal contexts.

Reformation Era Electrification Strategies

Indonesia's approach to electrification before the Reformation Era had been mainly to construct a combination of centralized and distributed power generation systems across the country. The centralized system consisted of large-scale power plants, substations, and power lines, built mainly on islands with high population densities. Small- to medium-scale diesel power plants with limited distribution lines made up the distributed systems, typically constructed in remote areas. One example of this is the Kutampi Diesel Power Station (*Pembangkit Listrik Tenaga Diesel* or *PLTD Kutampi*), built to serve the population of Nusa Penida, off the southeastern coast of Bali (figure 4.2).

Although several private companies and a few cooperatives participated in these electrification processes, PLN dominated Indonesia's electricity business. The main reason for this was the mandate of the country's 1945 Constitution for the state to control vital means of production, for the benefit of the people and to achieve social justice for all Indonesians. To the Indonesian government, electricity is a necessary commodity that must be reliably and affordably provided to all citizens, no matter where they live. Since the government did not wholly trust private companies to electrify unprofitable areas such as the countryside, it created a state-owned power company and instructed it to electrify Indonesia's territory.

Figure 4.2. Kutampi Diesel Power Station, in Nusa Penida. (Photograph by Anto Mohsin.)

Private companies could get a license to generate electricity for their own needs. However, all electricity surpluses that these companies wanted to sell to the public must be sold through PLN. This scheme provided little incentive for companies to join the electricity sector, and consequently there were not many independent power producers in the New Order period.

PLN's monopoly and its status as a state-owned enterprise have both advantages and disadvantages. With the government's support, it has evolved into one of the largest utility companies in the region, with tens of millions of customers and billions of US dollars of assets. PLN employees are civil servants, and they enjoy the benefits of that status—including job security and, for people in the higher echelons, a political connection to the ruling elites. But at the same time, the government controls how PLN conducts its electricity business. For example, the government appoints PLN's executives and sets electricity prices. These prices are complex and structured to differentiate among various customers (e.g., households, businesses, government offices, large industries, and street lighting). But they are set to ensure that many customers, particularly households in the countryside, can afford electricity. Fixing electricity prices artificially low (i.e., below the average cost of producing electricity)

has been a good political move for the ruling elites, so they have been reluctant to increase prices. Consequently, PLN does not earn any profits from sales to some of its customers.

Following the collapse of the New Order, PLN struggled to stay afloat. The value of Indonesia's currency took a nosedive and was significantly reduced against the US dollar because of the Asian financial crisis. PLN's finances were in trouble because, among other things, it needed to service its debt obligations and buy oil at the world market's prices. Consequently, no investments were made in new power plants between 1998 and 2001, and since no new power plants were constructed while demands for electricity kept rising, Indonesia experienced a power deficit in the 2000s. PLN had to implement rolling blackouts in many areas. At its peak, the power deficit affected more than two hundred cities across the country (*Fokus* 2010a). During these perilous times, PLN launched a nationwide energy conservation campaign to reduce electricity consumption. The government then initiated the first fast-track program to generate an additional ten thousand megawatts in 2006. This was followed by a second such program in 2010, which emphasized using renewable energy.

PLN finally managed to resolve the electricity crisis, in part because of the appointment of a new executive team at the end of 2009. Dahlan Iskan, a media tycoon, was put in charge of the power company. He and nine new deputies were sworn in on December 24, 2009 (*Fokus* 2009b). Although he was relatively new to the electricity business, Iskan proved to be an adept leader. He quickly won the hearts of many PLN employees, including those who had initially opposed his appointment, with his no-nonsense and down-to-earth leadership style. As a former reporter, he understood the importance of communication, which he conducted almost daily through events called Coffee Mornings. He also introduced a less hierarchical corporate culture and new ways of doing things.

Iskan cultivated a can-do attitude among PLN employees. Under his leadership, the company ended the rolling blackouts in mid-2010 by implementing an electricity emergency program (*Fokus* 2010a).[11] In another instance, he successfully led PLN to connect a million new customers to the electricity grid in a single day. That was less than half of the 2.5 million prospective subscribers on the waiting list, but what Iskan wanted to show was that it could be done. He also clearly understood the importance of symbolism and nationalism. He rolled out his "one million in one day" program on October 27, 2010, the day the country celebrated National Electricity Day (*Fokus* 2010b).[12] PLN achieved its goal, and this accomplishment helped boost the organization's confidence.

Assured of his accomplishments in 2010, Iskan set new goals in 2011. Aware of the national discourse surrounding borderlands and the inequality of existing

electricity access, he sought to electrify a hundred islands using solar energy (figure 4.3[13]). The majority of these islands, including several frontier islands, were located in eastern Indonesia.

PLN used two types of off-grid solar power plants. The first type was a 200-volt-ampere photovoltaic (PV) power plant that PLN called "communal PV" (*PLTS komunal*) because it could supply an entire community. The second type, known as "independent PV" (*PLTS mandiri*), would be installed independently at each house.[14] The independent PV is really a solar home system, consisting of a 12-watt-peak solar panel, 3-watt LED lightbulbs (highly energy-efficient SEHEN lamps), and a battery (Sambodo 2015, 113).[15]

Each independent PV subscriber made a deposit of 500,000 rupiah (about USD 55) at a local bank to get electricity access and paid a monthly fee of 35,000 rupiah (about USD 4) (Tjandring 2011). For most subscribers, the monthly fee was less than what they would have spent on kerosene. Even so, some electricity subscribers were unwilling or unable to pay—because their equipment broke down, or they lacked sufficient income, or the distance to the local bank was prohibitive. PLN also struggled to collect payments because it lacked accurate data on its independent PV subscribers (Sambodo 2015, 117).

The decision about which type of solar power plant to install depended on several factors, including a village's distance from the nearest PLN grid and its population density (Sambodo 2015, 113). For example, in the frontier islands of Miangas, Marampit, Makalehi, and Bunaken, the power company installed communal PVs (Kompas 2012). Miangas, the northernmost inhabited island of the archipelago, became the first island in Indonesia to have hybrid power generation, combining biomass, solar, and diesel. The Indonesian Museum of Records (MURI) acknowledged this as an important achievement and presented PLN with an award in May 2013 (Hidayat 2013).[16] Nine islands in the province of Maluku (Kelang, Pulau Tiga, Banda, Pulau Panjang, Manawoka, Tioor, Kur, Kisar, and Wetar) also received communal PVs, with capacity totaling 900 kilowatt-peak in 2013 (*Fokus* 2013).

Independent PVs turned out to be a good investment for PLN. The cost for installing them in remote areas was much less than that for extending its power grid, and the power company used these solar home system kits to illuminate hundreds of thousands of households. In July 2013, MURI bestowed another award to PLN for installing a hundred thousand SEHEN lamps in East Nusa Tenggara Timur Province within one year, and in September 2013, yet another award was given to Vickner Sinaga, a PLN executive in charge of East Indonesia operations and an innovator of SEHEN lamps (Hidayat 2013). Sinaga said that the MURI

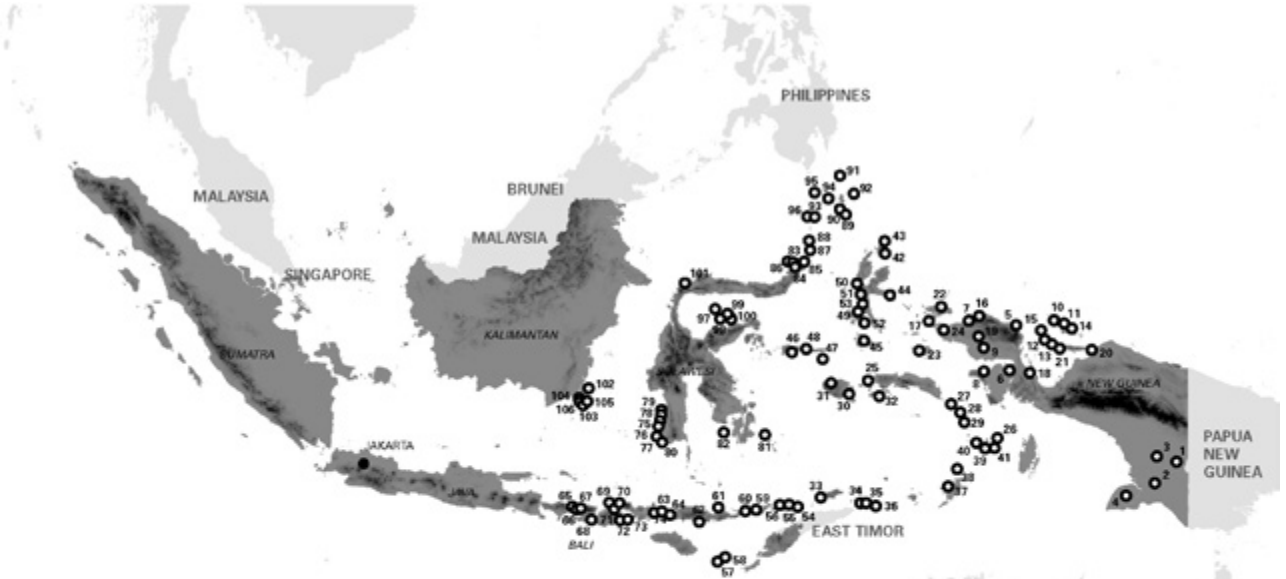

Figure 4.3. Locations of the hundred islands in PLN's solar energy program. (Map by Dorothy Tang.)

awards acknowledged PLN's efforts in lighting up remote regions and that the SEHEN lamps had been used in at least forty-five frontier islands (Hidayat 2013).

The SEHEN lamps were widely distributed, becoming very popular among thousands of residents in very isolated villages. Appreciative villagers enjoyed the cheap, clean, and bright electric lights. Some expressed a renewed sense of belonging to the nation. When Nunsaen villagers received independent PVs on December 24, 2011, their village chief, Marthen Manane, exclaimed, "We are now fully part of Indonesia, we receive electricity just like people in Jakarta. It is also timely considering we get it before Christmas, the birth of Christ, the Bringer of Light" (quoted in Tjandring 2011). Manane's comments expressed an important sentiment: many communities in isolated regions in Indonesia have long felt marginalized because for decades they were left out of the country's development agenda. Junaidi, a local government official in Tiga Barat Island in the Natuna archipelago, was quoted as saying, "In the past, we wondered whether or not we were still part of Indonesia because we never had PLN electricity. *Alhamdulillah* [thank God], for the last two years we have been enjoying PLN electricity" (quoted in Tanjung 2019).

In certain areas, PLN used both types of PV plants, as in Sebatik, the only border island that Indonesia shares with Malaysia (figure 4.4). In March 2012, a 340-kilowatt-peak communal PV began operation there, but since a few hamlets were still out of reach of PLN's distribution lines, in May the power company installed independent PVs for 150 residents in Lourdes (Ruru 2012). In 2013, Sebatik and Nunukan, the adjacent island, obtained additional electrical power via underwater cable from a natural gas-fired steam power plant located on the Kalimantan mainland (Trimukti 2013).

Developing Indonesia from the Periphery

In 2014, Indonesians elected Joko Widodo and Jusuf Kalla as their president and vice president, respectively. Both men had run on a platform widely known as *Nawacita* (Sanskrit for "nine goals"). President Jokowi (as he is popularly known) set "to develop Indonesia from the periphery" as one of these goals (Soleman and Noer 2017, 1964) in order to turn Indonesia into a "global maritime axis" (quoted in Shekhar and Liow 2014). He believed that territorially scaling up Indonesia's infrastructure would be essential in facilitating increased domestic trade, internal mobility, and inter-island connectivity, as well as in making Indonesia more globally competitive.

Taking advantage of low oil prices in 2014, he reduced the country's sizable domestic petrol subsidies and reallocated the state budget to increase funding for

Figure 4.4. Sebatik and Nunukan Islands. (Map by Dorothy Tang. Made with Natural Earth and GMTED2010 data. See GMTED2010 2011.)

repairing, building, and expanding Indonesia's roads, railways, seaports, airports, and power plants. He managed to more than double the state funds allocated for new infrastructure projects from 2014 to 2017. During his first term in office, he initiated more than two hundred "national strategic projects" across the archipelago (*Economist* 2018). His administration constructed more roads, airports, railways, dams, border posts, and bridges than any of his post–New Order predecessors. In a well-edited video showcasing the Jokowi administration's first-term accomplishments, the president said: "Only with an electricity network that reaches the entire *Nusantara* [Indonesian archipelago], seaports and airports that connect islands, dams that irrigate paddy fields, [and] roads and bridges that serve as logistical and transportation routes can Indonesia become an advanced nation. There is no other way" (Widodo 2019).

The statement, which connects Indonesia's future with infrastructure, sets the goal of countrywide electricity coverage. To use an analogy provided by Edwards (2003, 185), if "infrastructures are the connective tissues and the circulatory systems of modernity," then in Jokowi's mind, electrical current serves as the blood of those systems.

The Jokowi government acknowledged the country's existing power deficit and launched the "35,000 megawatts for Indonesia" project on May 4, 2015 (Wien 2015). The project involved constructing 109 power generating stations (PLN would build 35 of them, and independent power producers would build the remaining 74) in 210 locations across the country, most of which would be outside Java (Wien 2015). When this ambitious program was announced, some people were skeptical that it could be achieved, especially considering that the previous two fast-track 10,000-megawatt projects had suffered delays and failed to meet their five-year targets. In 2014, for example, the first of these projects was only 85 percent complete (Da Costa 2014). But Jokowi insisted on building his *Nawacita* electricity project, and he promised results. He framed the project as a "debt" that the government needed to repay to the Indonesian people because many citizens were still living without electricity (quoted in Wien 2015, 7).

Building on the momentum of his 35,000-megawatt project announcement, on August 28, 2015, Jokowi kicked off the Electrification of Fifty Frontier Islands and Border Regions Program (Program *Elektrifikasi Lima Puluh Lokasi di Pulau Terdepan dan Daerah Perbatasan*). The plan was to install 149 diesel power plants, which could supply from a hundred to a thousand kilowatts, in fifty locations spread over thirteen provinces. This project was undoubtedly important, although the technology chosen ran counter to PLN's attempts to use more renewable energy. Diesel power plants require high-speed diesel, a fuel whose use PLN has been trying to reduce since 2005 (*Fokus* 2005). Although PLN received government subsidies, the company was susceptible to the volatility of oil prices. Even when the prices were low, it was costly to procure diesel and transport it to remote locations.

PLN's rationale for choosing diesel power plants was that this choice was the result of a compromise. Even though solar panels would be much cheaper to operate, diesel power plants would be quicker and less expensive to build (Agustinus 2015). Speedy construction seemed to be the determining factor; Jokowi wanted to fulfill his campaign pledges quickly. Additionally, his *Nawacita* agenda promised not only to develop the country from the periphery inward, but also to ensure the state's presence in the borderlands (Soleman and Noer 2017). Providing electricity to these border regions would make the state visible to the projected 35,468 new electricity subscribers. The president also capitalized politically on the project by choosing the timing of the project's launch for its symbolic significance.

The launch was scheduled for the month when Indonesia celebrated the seventieth anniversary of its independence. The media, including PLN's internal magazine, covered the project as a special Independence Day gift to the residents of the fifty locations (*Fokus* 2015b).

One of these locations was the East Amfoang subdistrict in East Nusa Tenggara Province (Aditiasari 2015). Idrus Baleri, a resident in a border village there called North Netemnanu, noted a significant shift in his life and in the lives of many others in his village after the arrival of PLN electricity. His house and those of his fellow villagers were now brightly lit with electric lamps. He no longer needed to bring his phone to a neighbor's house to charge it, and his children could study better with electric lighting than they had been able to do with kerosene lamps. Now enthusiastic about his future, Idrus hoped to eventually start a small business (Amalo 2019).

PLN kept the spotlight on the border regions not just by illuminating new areas, but also by showing appreciation for some of its workers in outlying regions. On November 27, 2015, PLN invited forty employees to Jakarta to meet with the company's executives and to tour the headquarters and other facilities. It was a gesture of appreciation at the highest levels. The forty men, picked from some of PLN's most remote units across the country, were called "Electricity Warriors" (*Pejuang Listrik*), which likened them to heroes whose sacrifices and dedication to society were worthy of national recognition (*Fokus* 2015a). They were an eclectic group: operators, technicians, and maintainers of diesel power plants, as well as administrators and managers of small units. Their stay at the capital was brief, but their testimonials indicated that they were pleasantly surprised by their selection, and that they felt welcomed, appreciated, and entertained. The national discourse and attention on the borderlands helped elevate the status of this otherwise invisible workforce. In subsequent years, PLN periodically featured additional "Electricity Warriors" in *Fokus*, one of its internal publications. Even though it was long overdue, the acknowledgment of the contributions of PLN's low-ranking but essential labor force was a welcome change.

Electricity Conditions in the Border Regions

The Jokowi administration's emphasis on infrastructure development and nation-building from the periphery inward attracted much attention from the Indonesian media, which seized the opportunity to report on peripheral infrastructure's progress and its impact on local people. In turn, their coverage of Indonesia's borderlands increased traffic to their websites and social media accounts. In 2017, for example, *Detikcom*, an Indonesian digital media source, launched a multiyear,

multimedia project covering stories from the periphery (*Detikcom* 2022). Partnering with different enterprises, *Detikcom* has so far visited and reported on fourteen border regions. In late 2019, it partnered with PLN to write about electricity conditions and electrical customers in four areas, Miangas, Natuna, Nunukan, and Karimunbesar. The following stories are drawn from *Detikcom*'s coverage.

Asram, a fisherman in the Natuna Islands, reported that with the arrival of electricity he could go out to sea more frequently, because he could purchase ice (to preserve his catch) more often and more cheaply than before (*DetikFinance* 2019c). Other fishermen also reported an increase in revenues because they could better maintain the freshness of their sea harvests (*DetikFinance* 2019b). Ice blocks sold to Natuna fishermen are produced in a factory that doubles as a cold storage facility (*DetikFinance* 2019c). Roberto, the businessman who runs the facility, revealed that PLN electricity helped reduce his monthly electricity cost by half, down to 35 million rupiah (about USD 2,500) compared to when he used a diesel generator set, or genset (*DetikFinance* 2019a).

Nosnaima, a businesswoman in Long Midang Village, reported a similar new opportunity thanks to PLN electricity. She opened the Border Café along a newly constructed road near the West Kalimantan–Malaysia border in 2018 and has been running it since. Like many entrepreneurs in border regions, she had initially used a diesel genset to produce power for her café. PLN-supplied electricity enabled her to expand her business hours, and reignited her dream to build a small accommodation for tourists (*DetikNews* 2019c).

Another area affected by PLN electricity is education. Yosep Liang, a primary school principal in Long Midan, told *Detikcom* reporters that his newly electrified school was able to power computers for administrative and teaching purposes. He had once visited another school ten kilometers away in Malaysia, and had noted its more advanced facilities and pedagogical system. The availability of PLN electricity was a start, he said. His real hope was to have his school obtain the same resources as schools in big cities did (*DetikNews* 2019a). Sharon Abigail, a student at the Krayan State Primary School 006 in Long Midan, could not hide her joy that her home had PLN electricity. She had been used to studying at night using kerosene lamps with low light output (*DetikNews* 2019a).

Despite some successes, many communities continue to have inadequate electricity. The most important reason is the lack of underlying infrastructure. One significant characteristic of infrastructure is that it's "built on an installed base" (Star and Ruhdeler 1996, 113). The growth of electrical infrastructure relies on previously built infrastructure, which in most cases means paved roads. Smooth roads allow speedier transportation of materials and often serve as the paths along which electrical poles and distribution lines are erected. Many parts of Indonesia's

borderlands lack this installed base, which makes it challenging to electrify remote villages. In other words, the typically layered and hierarchical infrastructural construction that occurs in other places is not always considered or practiced in Indonesian infrastructural development.

Despite these conditions, PLN often erects electrical infrastructure with a nonexistent or minimal installed base. To PLN, these work-arounds are important in showing that growing an electrical network can be done despite serious obstacles, although of course these obstacles limit what the power company can achieve. When a one-kilometer distribution line was needed on the island of Natuna to power a repeater tower at the top of Mount Ranai, PLN had to figure out where to erect the poles and how to transport its equipment. PLN's truck-mounted crane could reach only a certain point because there were no paved roads going to the top of the mountain. PLN crew members carried the pole to its intended location on foot and dug a hole using portable drilling equipment (*DetikNews* 2019b). This kind of extensive labor (combining a lot of muscle power with the use of modest tools) exists alongside work done using more sophisticated equipment. Elsewhere, Umartono, a project manager in charge of installing a small wind farm on top of Nusa Penida's highest peak in the mid-2000s, recounted that he and his team had had to transport twenty tons of wind turbine components from Bali using two fishing boats tied together (*Fokus* 2007). A story on the Electrification of Fifty Frontier Islands and Border Regions Program was accompanied by photos of PLN employees working together with residents, hauling an electrical pole, carrying a genset with a wooden pole on their shoulders, and transporting machinery by boat (*Fokus* 2015b, 21).

PLN has not only faced the challenge of inadequate installed bases, but it has also struggled to maintain what it has successfully built. For infrastructure to function for a long time, it needs to be constantly maintained, and "old infrastructural designs must be constantly retrofitted to meet new contingencies" (Howe et al. 2015, 553). The issue for Indonesia's peripheral electrical infrastructure is less the lack of a trained workforce and more a problem of spare parts procurement. In every location where PLN has an electrical generating station, the power company employs an operator who usually doubles as a maintenance person. But when a machine breaks down, acquiring the necessary parts to fix it can take days or even weeks. This happened, for example, to Raja Jumaida, a PLN employee working in Sedanau, Natuna. He recounted that when one of his diesel machines broke down, he had to wait three days to receive the required spare parts by ship from Bintan, the closest place with available items (Tanjung 2019). Some situations are worse still: broken installations may be left unrepaired for months or even years. Solar panels on Miangas stopped operating in 2018, and the only remaining

electrical generator runs on diesel. Bad weather conditions between October and December often prevent transport ships from bringing diesel fuel on time, which means that electricity supply is precarious during those months (Safuroh 2019).

Infrastructures, Edwards (2003, 199) writes, "consist not only of hardware, but also of legal, corporate, and political-economic elements." These components normally support the construction and operation of infrastructure. However, sometimes the legal element can complicate rather than facilitate infrastructure's growth. On Karimunbesar, an island in the Strait of Malacca, some residents cannot receive PLN electricity because of a zoning rule.

PLN had previously experienced a power deficit on the island, so the local government asked the Ministry of Energy and Mineral Resources to invite private companies to help, especially in its Free Trade Zone (Rusdianto 2016). The ministry therefore passed a regulation in 2014 that divided the island into three electrical zones. The designated suppliers were PT Soma Daya Utama (SDU) for the first zone, and PT Karimun Power Plant (KPP) for the second zone. PLN received the concession to electrify the third zone. KPP built a gas-fired power plant, but by November 2019, SDU still had not completed its own power plant. Because of the ministerial regulation, residents in the SDU zone have had to continue using costly diesel gensets in the evenings. Unfortunately, now that PLN has more than enough power to supply electricity to households and businesses in all three zones, it cannot do so legally (Kusuma 2019).

Those who received PLN solar home kits also still have limited access to electricity. The systems can power LED lightbulbs, but not other electric devices such as televisions and refrigerators (*Fokus* 2012). PLN has promised to bring additional power to these villages by extending its distribution lines or installing power plants. But so far, this plan has not materialized. Thus, while PLN aimed to raise the overall share of electrified homes in the country from 85 percent in 2015 to 97 percent by 2019 (*Fokus* 2016), in reality, many people remain electricity-poor.

Conclusion

During the Reformation Era, a heightened awareness of Indonesia's borderlands prompted the Indonesian government to pay more attention to the country's periphery. The governments that succeeded the Soeharto regime shifted their perception of Indonesia's outlying areas, enacted laws, created a new national organization that manages borderlands, and constructed peripheral infrastructure. To electrify hundreds of villages in remote and border regions, PLN installed diesel power plants, communal PVs, and independent PV systems.

Endeavors to expand Indonesia's electrical infrastructure to the periphery received a boost during the Jokowi administration, which sought to scale up Indonesia's electrical infrastructure to reach long-neglected areas. PLN capitalized on the political and financial support it received from the government, launching several initiatives to increase electricity coverage and to install PV plants in new locations. PLN's infrastructure projects in the nation's periphery received media attention that promoted a new interest in Indonesia's borderlands by reporting on the lives of the citizens of those regions. When residents of many of these long-neglected border communities received electricity for the first time, they truly felt like part of the nation they had long observed from a distance.

However, as I have shown, although some notable efforts have been made to reverse the effects of center bias through the development of Indonesia's border regions and frontier islands, the country's peripheral electrical infrastructure has produced mixed results. Some border communities have enjoyed PLN electricity and increased attention from the national media. But many still either have no access to electricity or remain electricity-poor. Bringing Indonesia's borderlands into the national fold will be a continuing project for the Indonesian state. Indonesia's experience with electrifying its border regions thus far demonstrates that scaling up infrastructure territorially involves more than just increasing geographical coverage or adding another infrastructural layer. It raises questions of scale as a process rather than as a set of fabricated layers.

Notes

1. Another common spelling of Soeharto is Suharto.

2. The *Journal of Borderlands Studies* is one example of an academic journal that publishes work on borderlands by academics in various fields.

3. Indonesia's inadequate capacity to police its vast archipelago makes many of the country's maritime international borders porous. The smuggling of goods and people has been part of the country's reality since the colonial period (Tagliacozzo 2005).

4. These ninety-two islands are officially called *pulau-pulau kecil terluar* (small outer islands) in a government regulation specifying their management. The islands' names and coordinates are included in the regulation's appendix (Peraturan Presiden Republik Indonesia 2005).

5. Redrawn from https://kkp.go.id/djprl/p4k/infografis-detail/5794-111-pulau-pulau-kecil-terluar-ppkt-di-indonesia.

6. There were some exceptions. One was the electrification of Sangir, a remote island in North Sulawesi, to reduce the isolation of the islanders and decrease the inequalities between them and the more well-off neighboring population in the Philippines (Soemardjan et al. 1980, 87).

7. Wanadri and Rumah Nusantara published three books about their expedition (Pahlawan and Iskandar 2009, Soeratin 2011b, 2013).

8. Aat Soeratin (2011a), a member of the expedition team, gave a TEDx Talk in Bandung on March 11, 2011, describing his thoughts on frontier islands and his experience on the expedition.

9. Inspired by this expedition, PLN published a commemorative book titled *PLN's Light on Indonesia's Frontier Islands* (*Terang PLN di Gugusan Nusa Garda Terdepan Indonesia*), which uses the suggested new term (Sukrislismono et al. 2009).

10. Badan Nasional Pengelola Perbatasan was founded using Presidential Regulation No. 12 of 2010. A short description of the agency, including a list of its members, can be viewed online (BNPP 2020).

11. As electricity demands continued to grow and outpaced supplies, the country experienced another power deficit in late 2014. PLN worked to address the issue and solved it by August 2017 (*Fokus* 2017).

12. I wrote a brief article on the origins and significance of Indonesia's National Electricity Day (Mohsin 2017b).

13. Redrawn from http://www.radarindonesia.com/2016/04/menteri-susi-kirim-manajer-dan.html.

14. PLTS stands for *Pembangkit Listrik Tenaga Surya* (solar power plant).

15. SEHEN stands for *Super Ekstra Hemat ENergi* (highly energy-efficient).

16. Unfortunately, in 2018 the communal PV stopped operating because of a maintenance problem, and the islanders have since been relying on the diesel power plant, which uses more expensive fuel (Safuroh 2019).

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CHAPTER FIVE

Local Reservoirs and Chinese Aqueducts

The Politics of Water Security in Hong Kong

DOROTHY TANG

Hong Kong is located on the southern coast of China, bordering the city of Shenzhen and Guangdong Province. The territory was a British colony from 1842 until 1997, when it became a special administrative region (SAR) under Chinese sovereignty (figure 5.1). Following the original occupation of Hong Kong Island, the colony grew with the acquisition of the Kowloon Peninsula in 1860, and again with a ninety-nine-year lease of the New Territories in 1898. As a British colony, Hong Kong maintained a high degree of autonomy due to a mandate for financial independence from the metropole, and it became an early exemplar of free-market rule (Tsang 2004; Peck, Bok, and Zhang 2020). After a series of bitter negotiations, Britain and China agreed that the New Territories would return to Chinese rule when their lease expired in 1997. The 1984 Sino-British Joint Declaration hinged on the concept of *one country, two systems*, which was meant to ensure Hong Kong's political autonomy and capitalist development for fifty years after it was handed over to China. However, its relative autonomy from China has eroded after large-scale pro-democracy protests in 2014 and 2019, culminating in the enactment by Beijing of the 2020 National Security Law, which limits civil liberties that existed in Hong Kong.

Against this political backdrop, the infrastructural rationale of Hong Kong's water supply has evolved from territorial self-sufficiency to regional integration. The colonial government prioritized early public investments in freshwater infrastructure over other forms of urban infrastructure due to Hong Kong's steep terrain and lack of perennial rivers. During the major period of population growth in the 1950s and 1960s, the quest for water security motivated significant technological innovation at various scales, from the use of seawater to flush toilets in private homes, to expansive freshwater reservoirs reclaimed from the sea.

However, severe water shortages in the 1960s made it necessary to import water from China despite political tensions, and Hong Kong's quest for resource self-sufficiency abruptly ended. Since then, the primary function of water supply infrastructure has shifted from local water collection to the storage of imported water, which is delivered through an eighty-kilometer aqueduct from Dongjiang

Figure 5.1. Hong Kong's territorial evolution. (Map by Dorothy Tang.)

(also known as the East River), a tributary of the Pearl River (figure 5.2). With increased dependence on Chinese water supply, Hong Kong's water demand has shaped an integrated infrastructural territory beyond its own administrative borders. Today, approximately three-quarters of Hong Kong's fresh water is purchased from Guangdong Province, across the border in Mainland China.

Over the past two centuries, Hong Kong's water supply infrastructure has also played a significant role in shaping the politics of land supply and development in the region. The land area of the Hong Kong SAR covers 1,111 square kilometers, and had a population of approximately 7.5 million people in 2019. The territory is known for its dense urban development, and it has some of the highest real estate prices in the world. Yet only 25 percent of Hong Kong's land is classified as urbanized, and approximately 40 percent of the land is classified as country parks for nature conservation and recreation (Planning Department 2020).[1] The boundaries of country parks largely coincide with the catchment areas of reservoirs and were a by-product of water production during the colonial era. However, as reliance on imported water from China increased, the political impetus for watershed protection has diminished. Since the 2010s, Beijing and the Hong Kong government have concluded that the housing shortage is at the heart of social discontent in the territory (Siu 2019), and they have stepped up their efforts to increase land supply. These strategies include converting colonial-era golf courses into development sites, building artificial islands, and a controversial proposal to rezone country parks for housing (Ng 2017). As a result, the utility of watershed protection has reentered the political sphere.

This chapter examines the development of post–World War II water supply systems at multiple spatial scales, as well as the discourse pertaining to self-sufficiency as Hong Kong transitioned from a British colony to an SAR of the People's Republic of China. Hong Kong's physical landscape is represented as the underlying reason for water scarcity, and it is continuously transformed by freshwater infrastructure

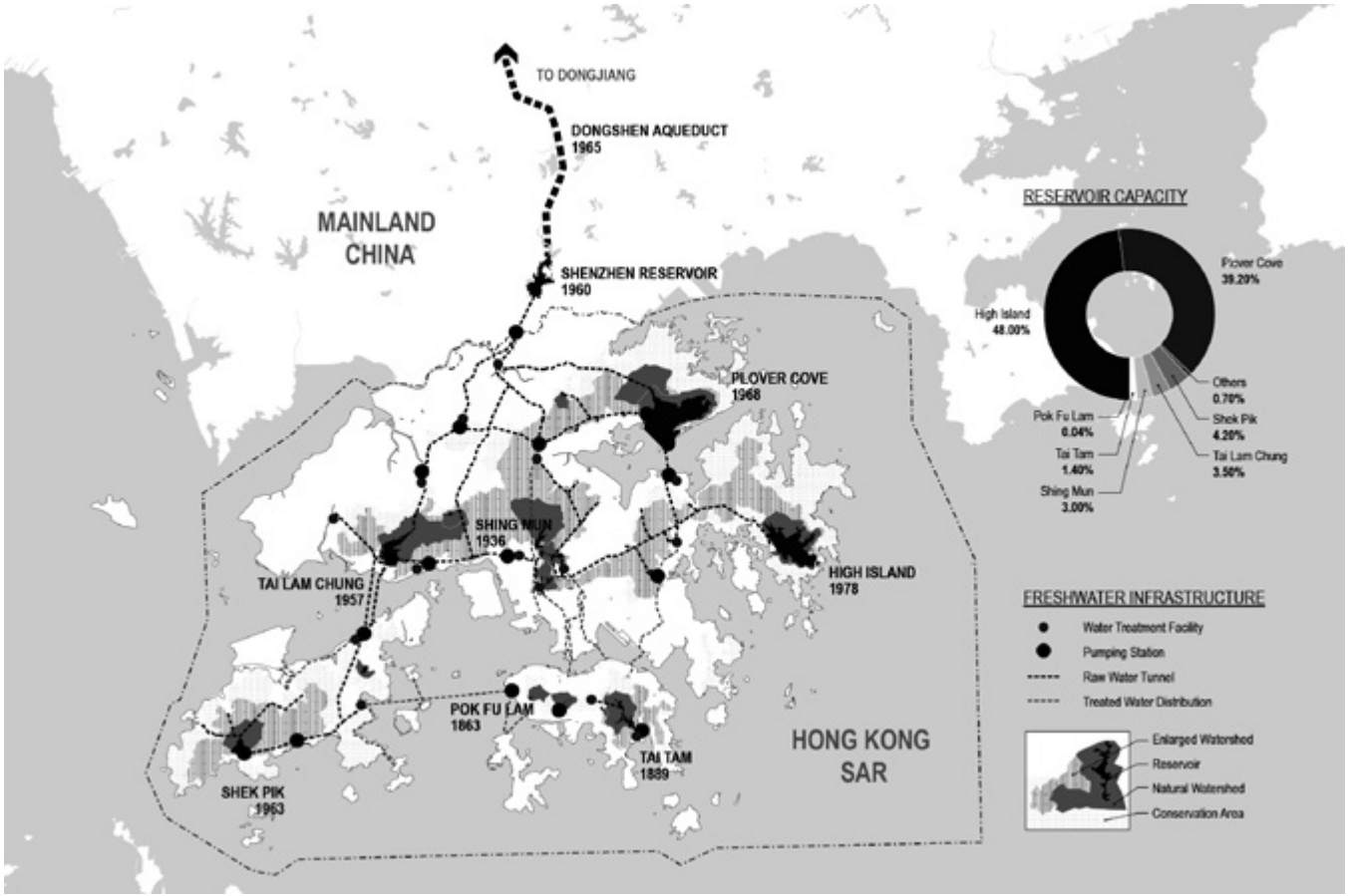

Figure 5.2. Hong Kong's freshwater infrastructure. (Map by Dorothy Tang. See WSD 1978.)

to meet the demands of a growing city. In particular, the response to water emergencies in the 1960s exemplified the fragile geopolitical negotiations between the British and the Chinese, which coincided with significant technological innovations and major landscape transformations within the territory. Over time, the Hong Kong government has maintained a delicate balance, maximizing local water production while depending on imported water from the mainland, and the scales of freshwater infrastructure are adjusted and reconfigured during times of political tension and conflict. Despite a period of stable supply as the British gradually ceded control of Hong Kong, renewed conflicts since the mid-2010s between Hong Kong's political autonomy and Chinese sovereignty have revived debates about water self-sufficiency versus reliance on the so-called motherland. Rather than signifying modernity and progress, the engineering achievements of Hong Kong's freshwater infrastructure reveal instead the multiple forms of political subjectivity in the territory's recent past.

My account of Hong Kong's water supply infrastructure questions the common assumption that modernization, capitalist development, and nationalism are the main drivers behind large-scale infrastructure development and its accompanying institutions. Modernity and infrastructure are often understood to be coproduced by mediating nature across multiple scales, times, and social organizations (Edwards 2003). The modernist impulse to stabilize environmental variability produces a new form of nature that in turn shapes infrastructure, and consequently the experience of modernity and its political institutions. This cyclical relationship between infrastructure and nature expands spatially and temporally as natural systems (such as forested watersheds) are absorbed to enhance infrastructural performance (such as reservoir capacity) (Carse 2012). By delving into political action observed at different scales during the water emergencies of the 1960s, I offer an alternative entry point into the hydropolitics of the region and how infrastructure shaped, and was in turn shaped by, the shifting relationship between Hong Kong and Mainland China, allowing us to better understand the technopolitics of key infrastructure projects completed between the late 1950s and 1982, as well as the coevolution of infrastructural territories on both sides of the border.

This is accomplished through a detailed analysis of the politics, infrastructure, and landscapes of water supply in Hong Kong. I first set the stage by showing how pre-war water supply infrastructure in colonial Hong Kong created a reciprocal relationship between urban growth and landscape resources. This is followed by an analysis of how Sino-British geopolitics during the water emergencies of 1963–1964 and 1967 shaped water supply infrastructure development until the Handover in 1997. Last, I turn to recent political debates over water security and their landscape implications. This chapter draws on archival sources available at Hong

Kong's Public Records Service, original consultancy reports at Hong Kong's Water Supplies Department, and publicly available reports and documents produced by various institutions and individuals.

Engineering the Barren Rock: Water Supply for Early Colonial Hong Kong

When Hong Kong Island was formally ceded to the British in 1842, after the First Opium War, the metropole's disapproval of the island's inhospitable landscape and poor strategic location was expressed with resounding derision by Foreign Secretary Lord Palmerston, who described the new colonial outpost as a "barren island with nary a house upon it" (quoted in Peck, Bock, and Zhang 2020, 1).

Indeed, although Hong Kong has abundant rainfall, seasonal variation reduces the reliability of perennial mountain streams. The mountainous terrain drains water quickly and lacks large natural bodies of water. The geology of Hong Kong mainly consists of volcanic and granite rock formations with shallow surface soil, little capacity for groundwater, and no natural aquifers (Ho 2001, 6). The same volcanic geology that formed Hong Kong's advantageous natural harbor also limits its freshwater resources. Therefore, official histories of Hong Kong's water supply typically begin with the double challenges of overcoming the territory's physical landscape and meeting the demands of population growth (see Ho 2001).

Before Hong Kong's first freshwater reservoir was built, the colony relied on seasonal streams and wells for fresh water. At the time of the British occupation in 1841, the population consisted of 7,450 people, including approximately 2,000 boat dwellers, and the available water resources were more than sufficient. The population increased dramatically following the establishment in 1842 of the City of Victoria as the colony's first urban settlement. Within ten years, the colonial government had dug the first publicly funded wells to serve a population that had more than quadrupled, to 32,983 people, and they began to devise plans for Hong Kong's first freshwater reservoir, Pok Fu Lam Reservoir, located in a valley in the northwestern part of the island. However, by 1861, before its completion, Hong Kong's population had grown to 119,321 people due to the expansion of the colony to the Kowloon Peninsula and an influx of migrants fleeing the Taiping Rebellion. When Pok Fu Lam Reservoir was finally completed in 1863, it was already insufficient for the needs of the city, and it was expanded in 1877. The next major water project was the completion of Tai Tam Reservoir on the south side of the island in 1889, which was expanded again between 1904 and 1908. By the early twentieth century, with the lease of the New Territories, Hong Kong's population had more

than tripled again to 386,159 people, with the vast majority living on Hong Kong Island (Ho 2001, 242–244; Swee-Hock and Kin 1975, 131).

The initial development of water resources in Hong Kong was concurrent with mid-nineteenth-century innovations in water supply systems in Britain and its colonies, where the assessment of water resources and their potential for expansion had become important components of town planning. These systems relied on the capacity of a natural landscape to collect and store water, and they used gravity-fed pipes to supply urban settlements. A typical gravitation scheme consisted of a large source of water that was collected and reserved, often in impoundment reservoirs, before being conveyed by gravity across a significant distance through some form of pipeline. Impoundment reservoirs were often located far from urban settlements, not only because of the technical considerations of location and size, but more importantly because engineers believed that reservoirs' considerable distances from polluted cities ensured higher water quality. The water catchment areas were legally protected from urban development through buffer zones or conservation areas to prevent further contamination and, in the colonies, often involved the forced relocation of people in existing settlements (Broich 2007, 358–359).

In Hong Kong, in addition to the space taken up by the new reservoirs, large tracts of land were required for a system of catchwaters to maximize water yields. Catchwater channels were carefully engineered to circle around the slope beyond the watershed ridges and drain into the lowest point of the reservoir, thus greatly expanding the natural catchment areas. Narrow footpaths adjacent to these lined channels enabled appropriate maintenance, and over time they have evolved into extensive hiking trail systems in Hong Kong's country parks. The catchwaters also demarcate the boundaries of conservation zones established to minimize the adverse impacts of human activity. These conservation zones were typically afforested to prevent soil erosion and protect the steep slopes, and Indigenous villagers were prohibited from using the timber for fuel (Ho 2001, 30; Peckham 2015). In contrast to typical colonial forestry practices, afforestation in Hong Kong was necessary for securing water supply, and it eventually laid the foundation for an ecologically driven conservation strategy after World War II (Corlett 1999).

Hong Kong's population continued to balloon, and occasional dry years and major droughts in 1902 and 1929 threatened the colony's economy and public health. With the acquisition of the New Territories in 1898, the colonial government had finally gained access to additional land and potential water resources. Shing Mun Reservoir, located near Shatin in the New Territories, was completed in 1936. At eighty-five meters tall, it included the highest dam in the British Empire at the time (Broich 2007). The innovative structure is a near-vertical reinforced

concrete diaphragm wall, with a wedge on the downstream side filled with sand and reinforced with rock to accommodate uneven settlement in the event of an earthquake. Construction was completed in fifteen months and under budget (Twort 1990, 19–20). However, although the reservoir more than doubled the territory's reservoir storage capacity, at the onset of Japanese occupation in 1941 the water resources of Hong Kong had already been exploited to full capacity.

As the British territory expanded, so did the water supply network and the accompanying landscape transformations from barren rock to lush subtropical forest. The first century of urbanization and water supply development set a foundation for subsequent water governance strategies ranging from the scale of the territory to the domestic sphere. Despite the liberal economy that was crucial to maintaining the colony's relative autonomy from the metropole (Tsang 2004), Hong Kong's water utility remained a public entity—in contrast to privatized utilities in Hong Kong such as electricity and, later, mass transit (Kwong 1997). The centralized and systematic planning required, and its mandate as a public good, necessitated this governance structure, which was solidified by complex geopolitics across the border with Mainland China after World War II.

Post-War Geopolitics and the Quest for Water Self-Sufficiency

In the wake of dramatic geopolitical shifts in East Asia immediately after World War II, the status of British sovereignty over Hong Kong was tenuous. Only after the Chinese Civil War concluded with the establishment of the People's Republic of China in 1949 would a tacit agreement emerge between China and Britain for Hong Kong to remain a British colony until an agreement about the New Territories lease could be achieved (Tsang 2004, 130–131). This political uncertainty not only shaped the colony's future governance, but it also produced a paradoxical relationship between engineering water independence from the mainland and needing to meet growing demand as a result of a massive influx of migrants and a burgeoning industrial sector. Nelson Lee (2014) describes this period of water supply development as a competition between the colonial government's desire for a local supply, and China's offer to provide water from Guangdong Province, while the media scholar Cheung Siu-Keung (2014) goes a step further and interprets these events as an overt effort by China to exert biopolitical control over Hong Kong. Both arguments suggest the inevitability of Chinese hegemony over Hong Kong. However, they overlook the fact that the crisis of colonial governance in the face of the dual emergencies of social unrest and water shortages during this period set the stage for local politics.

The following analysis examines how the relationship between Cold War geopolitics and water supply infrastructure ecology shaped late colonial governance in Hong Kong.

Post-War Recovery versus the Great Leap Forward

The planning and construction of Tai Lam Chung Reservoir in the western New Territories were interrupted by World War II, and due to other immediate recovery needs and a lack of financing, they did not resume until 1953. The forty-meter masonry-faced concrete gravity structure added almost twice the storage capacity of Shing Mun Reservoir (Twort 1990, 33). However, despite these impressive improvements, increased migration from China meant that Tai Lam Chung Reservoir barely made a dent in Hong Kong's water deficit.

At the same time, China was undergoing its own modernization drive, the Great Leap Forward,[2] and numerous primitive dams and reservoirs were constructed throughout the country—including Shenzhen Reservoir, located on the Chinese side of the Shenzhen River, which forms the border between Hong Kong and China. Work on the reservoir began in November 1959 and was completed in four months (Lee 2014, 915–916), just in time to play a major role in Hong Kong during a drought year. The Guangdong provincial authorities approached Hong Kong in January 1960 and offered water from Shenzhen Reservoir to alleviate Hong Kong's water burden. After several negotiations held in railway station waiting rooms in Shenzhen and Lo Wu, the Chinese authorities and their British counterparts reached an agreement for Hong Kong to import five billion gallons of water annually for an indefinite length of time. Hong Kong paid for the ten miles of steel pipes and appropriate pumping facilities needed to move water across the border, and this began the colony's importation of water from the mainland.[3]

Planning for Long-Term Water Security: Reservoirs in the Sea

Despite the temporary reprieve, Hong Kong continued to pursue other options, such as Shek Pik Reservoir, for water supply. After careful studies of Hong Kong's physical environment in search of new reservoir sites, the idea of reclaiming the sea for a freshwater reservoir had emerged in 1958 (Plover Cove 1970). In 1961, the Hong Kong government commissioned the British engineering firm Binnie & Partners (in collaboration with the Hong Kong-based Scott and Wilson, Kirkpatrick and Partners) to develop a masterplan for the scheme. The Plover Cove and Hebe Haven Scheme (Binnie et al. 1962) proposed the reclamation of a natural cove in Tolo Harbour, in addition to a network of catchwaters, tunnels, and pipelines

connected to a new water treatment facility in Shatin. The colonial government began the first phase of the scheme with the construction of Plover Cove, consisting of a 2.1-kilometer main dam connecting Tai Mei Tuk to Harbour Island and two subsidiary dams. When it was completed in 1968, Plover Cove more than doubled the total storage capacity of the existing reservoirs in the territory (figure 5.3).

Meeting the technical challenges of converting a saltwater cove into a freshwater reservoir required a great level of innovation. The total height of the dam is 44 meters, but its base is 28 meters below sea level (figure 5.4). The main dam required dredging a 200-meter-wide foundation trench along its length, at depths of as much as 17 meters (Elliot, Ford, and Oules 1972). However, the greatest challenge was removing salinity from the reservoir bed (Ford and Elliott 1965). The engineers devised a process in which the majority of the seawater would be pumped out during the dry season, leaving just enough water to avoid disturbing the sea mud, and then diluting the remainder by pumping out the first flush of rainwater until the salinity levels met certain standards. Then the remainder of the wet-season inflow would be allowed to accumulate. Depending on rainfall, this process could take up to a year before normal impoundment could commence, and the engineers speculated that salinity levels would continue to drop over time.

In converting a marine ecology into a freshwater ecosystem, engineers worried that the initial decline of marine benthic species and an increase in invasive species could threaten the water quality of the reservoir and breed mosquitoes (La Touche, Smith, and Townsend 1972). Thus, a full-time marine biologist was hired to survey the conditions and propose a reasonable transition. Carefully selected fish species—commonly referred to as fry fish in Hong Kong—were stocked in the reservoir to control algae growth and insects, and by 1969, additional predatory species were introduced to manage the populations of black mussels and other invasive species (Water Authority 1979; La Touche, Smith, and Townsend 1972).

The 1963–1964 Water Emergency and Importing Water from China

During the early stages of planning for Plover Cove Reservoir, Hong Kong experienced one of its most harrowing water shortages in history. The government struggled to provide constant and universal water supply for the population of over 3.5 million, even during times of typical rainfall. An unusually dry wet season in 1963 almost drove the city to its brink. Water rationing was the norm for a year and a half in 1963 and 1964, including especially stringent periods when water was supplied for only four hours every four days. Shenzhen Reservoir also suffered from the drought and could not supply additional water to Hong Kong.

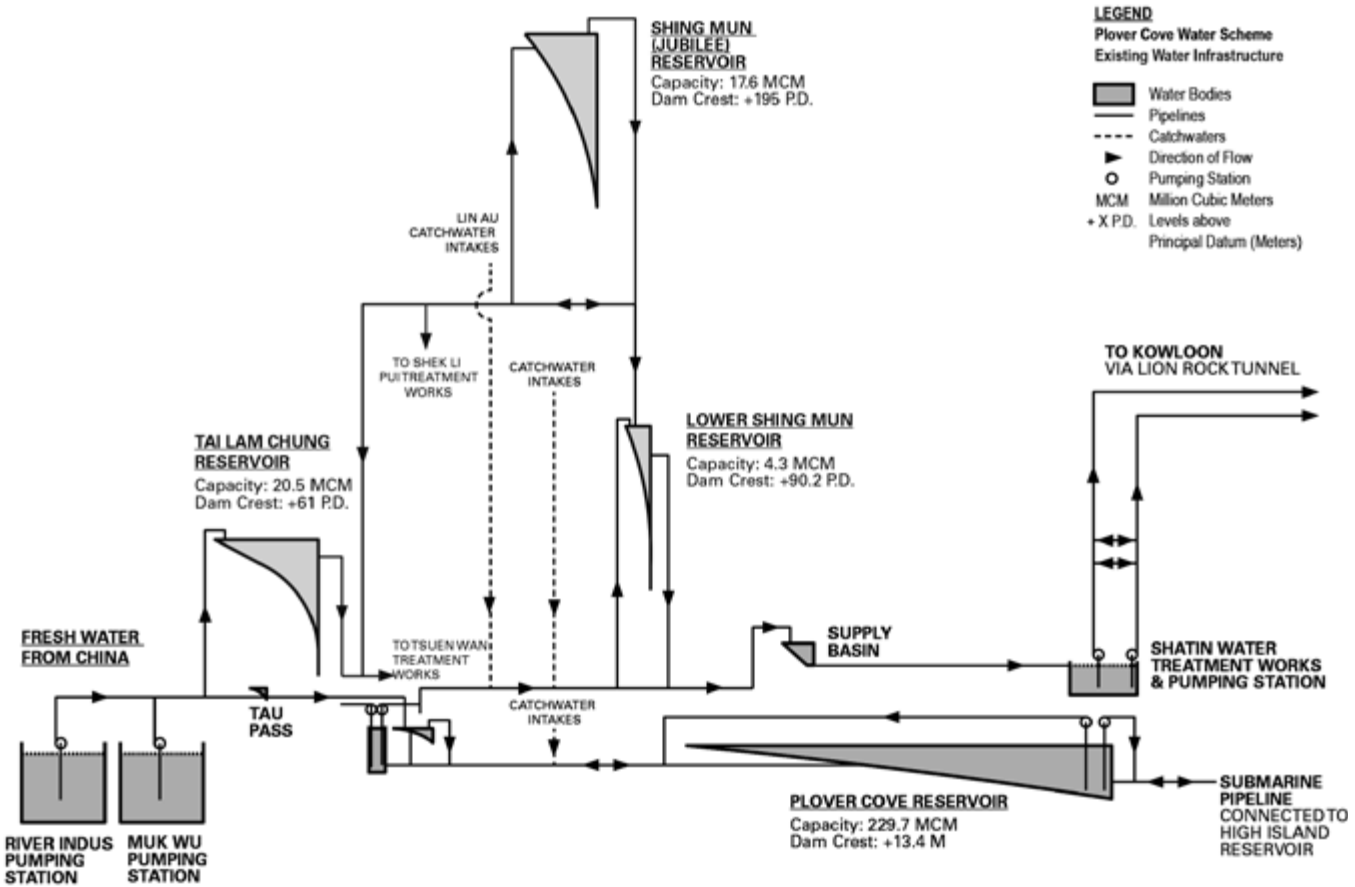

Figure 5.3. Plover Cove Water Scheme diagrammatic layout. (Illustration by Dorothy Tang. See Binnie et al. 1962.)

Figure 5.4. Aerial view of Plover Cove Reservoir. (Photograph by Dorothy Tang.)

E. P. Wilmot-Morgan, the deputy director of the colony's Public Works Department, led a delegation to meet with Guangdong provincial authorities in Guangzhou in early June 1963, to discuss various options of importing water (including both raw water and treated tap water) from Dongjiang to Hong Kong by ship. Throughout the negotiations, Guangdong authorities emphasized that they were willing to offer water (including tap water) at no charge because the water shortage in Hong Kong was at the level of a "national calamity," and they feared that importing water might increase water charges for Hong Kong customers. While Wilmot-Morgan accepted the offer of free raw water, he declined to receive tap water for free, insisting instead on paying the same rate that Hong Kong was charged for its annual allowance of water from Shenzhen Reservoir. In late July 1963, the colonial government launched Operation Water, in which a fleet of ten tankers would travel up the Pearl River Estuary and ship water from Dongjiang to supplement Hong Kong's water supply.[4]

The delegation also explored additional possibilities for increasing the water supply, such as constructing a temporary barrage across the Shenzhen River to divert more river water into the Hong Kong system, and installing a pipeline from Dongjiang to Shenzhen Reservoir.

The Guangdong representatives were taken aback by the suggestion of the pipeline and suggested that for a project such as this, the Hong Kong government would need to approach the central government in Beijing directly. In a telegram to the British secretary of state of the colonies, Governor David Trench of Hong Kong explained the necessity for the project: "I am bound to consider the possibility that grave weather conditions will continue . . . [T]his would undoubtedly have a serious effect on industry in particular, and on public confidence in Government generally."[5] In the meantime, it was essential to pursue the pipeline as an emergency reserve option until Plover Cove Reservoir was scheduled to start operation in 1968. Trench concluded that the pipeline infrastructure could be made available to the Chinese for irrigation after Hong Kong met its water supply challenges. Beijing agreed to the proposal and subsequently instructed the Guangdong authorities to proceed in assisting Hong Kong with the pipeline. Premier Zhou Enlai himself made a visit to the construction site in 1963 to demonstrate the importance of the project (*Wen Wei Po* 2015).

The Hong Kong government was aware of the potential pitfalls in collaborating with a politically volatile regime, particularly "the possibility that on the orders of a single individual, over whom the Hong Kong government has no control, all supplies could be cut off without warning."[6] Nonetheless the project proceeded, but on Chinese terms. Rather than building a closed pipeline as proposed by the Hong Kong Public Works Department, the Guangdong authorities constructed an eighty-kilometer-long open canal from Dongjiang to Shenzhen Reservoir. The canal reversed the flow of an existing tributary, Shima River, through six large regulating dams and nine pumping stations that ultimately connected to Shenzhen Reservoir, where the water flows through an artificial channel into Hong Kong's water supply network (figure 5.5). Journalists marveled over the Chinese project, which was completed mostly with manual labor and employed over nineteen thousand workers at the height of operations. All of the machinery used and equipment installed were made in China, and the massive project was completed in eight months (*Financial Times* 1965; *Times* 1964). Another new water agreement was signed for fifteen billion gallons of water annually, three times the amount allocated in the 1960 agreement. And on March 1, 1965, the waters from China flowed.

The 1967 Riots and Saline Drinking Water

July 1967 was a difficult month in Hong Kong. In April, riots had begun after the Hong Kong Artificial Flower Works fired 650 workers. The mass firing instigated a labor movement with tacit Chinese support, while across the border, Mao's Cultural Revolution was well under way. In Hong Kong, anti-British sentiment converged with communist sympathies in the most violent political unrest in the

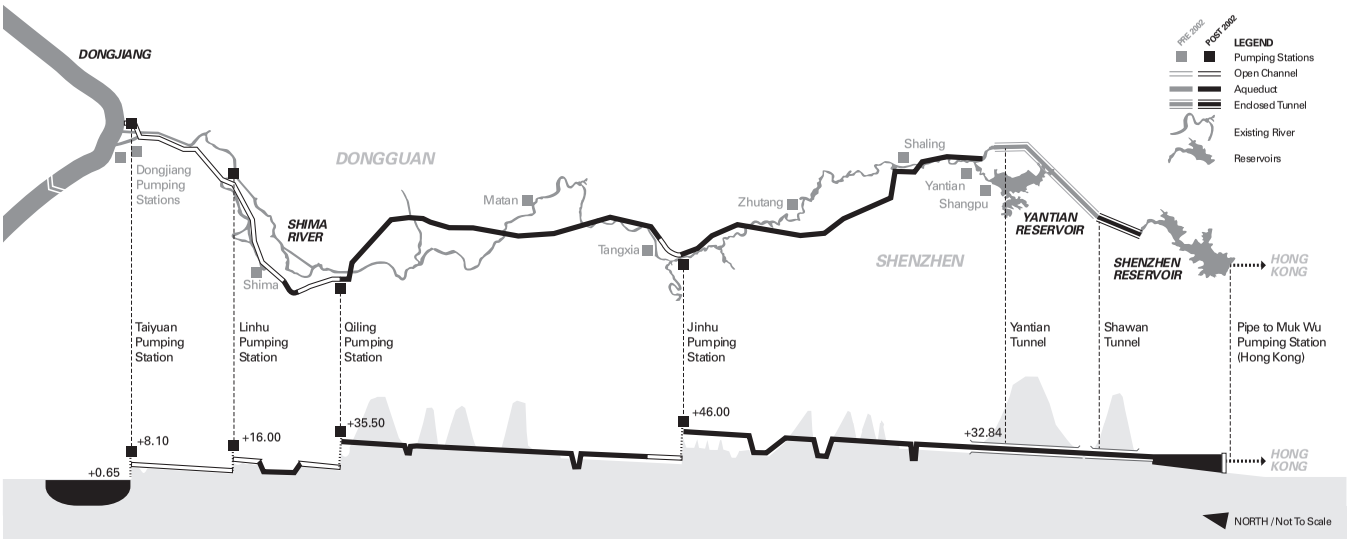

Figure 5.5. Dongjiang aqueduct alignment and pumping stations. (Illustration by Dorothy Tang. See WSD 2015.)

colony's history, resulting in six months of riots and fifty-one deaths. By the end of June, Hong Kong had experienced a general strike, which halted food imports from the mainland and coincided with the end of the annual water supply period determined by the new water agreement with China. On July 8, a bloody border dispute with mainland militia rocked colonial Hong Kong. And on July 13, the government again enforced water restrictions by limiting supply to four hours every fourth day. The situation was so dire that the British colonial government contemplated the possibility of leaving Hong Kong (G. Cheung 2009).

In the midst of the fraught political situation, representatives of the colonial government approached their Guangdong counterparts to request additional water throughout the summer, but they were met with silence. Although the main construction of the Plover Cove system was complete, the desalination process still required another year before the system would be fully in service. There was one heavy rain event at Plover Cove on July 13 and 14, and the colonial government started exploring the possibility of using some of that rainfall.[7] The Water Authority immediately began to discuss acceptable levels of salinity in drinking water, referring to a World Health Organization recommendation of nine hundred parts per million as an upper limit with regard to taste, but ultimately deciding that fifteen hundred parts per million was an acceptable level that would not endanger public health. It also began a survey of water consumption habits in the colony, and noted that water consumption in affluent parts of the city was very high and should be the principal target for a water-saving campaign. Finally, in mid-August the government announced that it had to supplement its water supply by increasing salinity levels, which included saline water from Plover Cove.

In a memo that Trench sent to the secretary of state of the colonies on July 25, he lamented that, even with normal rainfall and the completion of Plover Cove, Hong Kong would still require assistance from China to maintain a constant supply of water, and he suggested the exploration of additional reservoirs or water sources.[8] As the colony proceeded with its water emergency measures, the Water Authority began to consider the possibility that, given the anti-British rhetoric of the riots and the unstable political situation in China, water from Dongjiang might not come through, even with a stipulated annual supply period from October to June. The colony was relieved when water from Shenzhen was resumed with "an hour's notice" on October 1, and that things seemed to be back to normal. However, the Chinese failure to respond to Hong Kong's request earlier that summer prompted the colony's Executive Council to seriously consider the possibility that the water supply could be discontinued without notice for political reasons.[9]

One direct outcome of addressing the uncertainty of the water supply from across the border was the strengthening of the local water supply. This was

accomplished first by increasing the height of Plover Cove Reservoir by four meters and expanding its catchment; second by abandoning the next phase of the planned Plover Cove and Hebe Haven Scheme, in favor of exploring another site for an even larger reservoir; and third by the government's revisiting options for desalination.

Despite the recommencement of sorely needed water supply from Dongjiang, the amount of water stored by the colony remained unusually low. Water restrictions were lessened, but the Water Authority continued to mix saline water in the water supply until February 1968. This strategy to increase water supply was not without controversy. Industries, especially the dyeing industry, could not tolerate increased salinity levels, and Hong Kong's electrical companies needed fresh water for their generators. Most importantly, tea drinkers were unhappy with the saline content in their water. At a press conference in December 1967, implications that saline water was unequally distributed resulted in an exasperated response from the Water Authority, which stated, "We have modified our water distribution to distribute saline water as widely and fairly as we can," and concluded, "People on the Peak get the same sort of water as anyone in Wan Chai or Yau Ma Tei."[10]

These complaints were more than just petty concerns. Due to the riots, the British colonial government in Hong Kong had suffered a blow to its credibility and ability to govern, and while the colony would see extensive social reforms in the upcoming decade, 1967 was still a very delicate time. The deputy colonial secretary was concerned about how discontent with saline water was being "exploited by the communists," and he believed that fresh water from China was offered as a propaganda measure.[11] Indeed, between 1967 and 1969, the leftist Chinese newspaper *Ta Kung Bao* (1967) published articles with sensational claims such as "British Hong Kong supplies saline water and uses safety as an excuse," and further claiming that the British "are lying about the health impacts in revenge for our countrymen's actions in May. The reservoir has rotting biomass and sea water, how is it not poisoned or dirty?" An unintended consequence of bringing Plover Cove into operation before desalination was complete was the increased politicization of Hong Kong's water sources.

Localized Resources: High Island Reservoir and Lok On Pai Desalter

It is important to note that while Dongjiang was an important source of water for Hong Kong in the 1970s, it accounted for only 22–26 percent of the colony's water consumption (Lee 2014, 914). Although Hong Kong's freshwater infrastructure had not yet caught up with the growing water demand, the colonial government was optimistic that a solution to water security could eventually be engineered. The proposed High Island Reservoir and Lok On Pai Desalter would be Hong

Kong's most ambitious attempts yet for water autonomy, both in terms of scale and of technological innovation.

The High Island Reservoir is located in the northeast New Territories on the Sai Kung Peninsula. It replicated the engineering strategy of Plover Cove by constructing a freshwater reservoir out of a marine environment. After its completion in 1978, it had a storage capacity of 273 million cubic meters of water, which is approximately 22 percent more than Plover Cove—effectively more than doubling Hong Kong's existing water storage capacity. Together, High Island and Plover Cove Reservoirs have the capacity to store over 85 percent of Hong Kong's water reserves. The reservoir itself has a smaller footprint than Plover Cove, but has an overall height of 107 meters, and its engineered water catchment area covers virtually the entirety of the Sai Kung Peninsula. Despite the serious design and engineering challenges of the project, the colonial government spared no efforts in creating this last and largest reservoir.

Simultaneously, serious efforts were put into developing alternatives for desalination, and after years of piloting, the colonial government decided to use newly developed multistage flash distillation technology as the basis for a desalination plant. Construction began in 1973, and Lok On Pai Desalter, the world's largest desalination plant, was completed in 1975. At its peak, the plant produced 12 percent of the water consumed daily in Hong Kong. However, the energy costs of the process were staggering, and after one year of unusually abundant rainfall, the desalter was temporarily closed at the end of 1978. It was temporarily revived during an exceptionally dry year in 1981, but decommissioned again in 1982, and it was completely dismantled in 1992 (Ho 2001, 202–206). Lee (2014) explains that, given the exceptional capital and operational costs for localized supply, the colonial government was increasingly criticized for not using the much cheaper water from Dongjiang.

The Sino-British Declaration and the End of Water Rationing

At the dawn of the reform era in China, there was once again optimism for the future, and border tensions eased significantly. In addition, Britain began negotiations with China over Hong Kong's future. Although initial negotiations between the British and China were contentious, it was widely acknowledged that Hong Kong's future was with China, and thus there was no strong political reason for Hong Kong to insist on water autonomy. By 1980, even with the completion of High Island Reservoir, the proportion of the colony's water coming from Dongjiang had increased to approximately 40 percent.

New water agreements with Shenzhen required infrastructural upgrades on the Hong Kong side. These upgrades were implemented over twelve years and spread across many distributed projects, but taken as a whole, they represented

one of the largest freshwater infrastructure investments that Hong Kong had made to date.[12] The purpose of these infrastructural upgrades was to convert the existing water supply system from a collection system to a storage system for Dongjiang water. By 1982, water rationing had formally ended, and in 1984, the year that the Sino-British Declaration was signed, Dongjiang provided 50 percent of the water consumed in Hong Kong. This reliance on Dongjiang water has dramatically increased (accounting for approximately 75 percent of Hong Kong's water in 2019), which signals the culmination of an enormous shift in the hydropolitics of Hong Kong, from a condition of relative autonomy to one of systematic integration with the mainland (figure 5.6).

Post-Handover Infrastructure and New Politics of Water Security

In 2019, Hong Kong experienced more than half a year of violent protests in one of the greatest political crises in its history. After protestors successfully disrupted operations at Hong Kong International Airport, the overseas edition of *China Daily* published an interview with a Chinese expert based at the National University of Singapore, who joked about the possibility of ending the protests by cutting off Hong Kong's water supply (Zhang 2019). Controversy among both Hong Kong and Mainland Chinese commentators immediately ensued, and the scholar quickly issued a clarification condemning the use of his comments out of context. Despite this correction, Chinese state media maintained that Hong Kong "separatists" should consider the reality that Hong Kong's daily necessities, such as "water, electricity, meat, vegetable and fruits," rely on mainland resources (Yang and Wang 2019). Cheung Siu-Keung has argued that China's increased contribution to Hong Kong's water and food supply since the 1960s was a deliberate political maneuver to weaken British negotiations (2014, 1016–1018) and a demonstration to Hong Kong residents of benevolent rule (2014, 1024).

Indeed, water security has played an important role in postcolonial discussions of the future and autonomy of Hong Kong. In 2017, environmental policy think tanks Civic Exchange and ADMCF co-published a scathing report titled *The Illusion of Plenty*, which criticized Hong Kong's water security strategy with regard to increased competition in the Dongjiang watershed and the territory's wasteful water provision policies. The analysis implied that the Hong Kong government's water strategy had been "uninspired" (2017, 5) because of an overreliance on water from Dongjiang and poor water pricing structures. This false sense of security, the report argued, is based on the exorbitantly high price that Hong Kong pays to guarantee a fixed quantity of supply compared to other cities in the

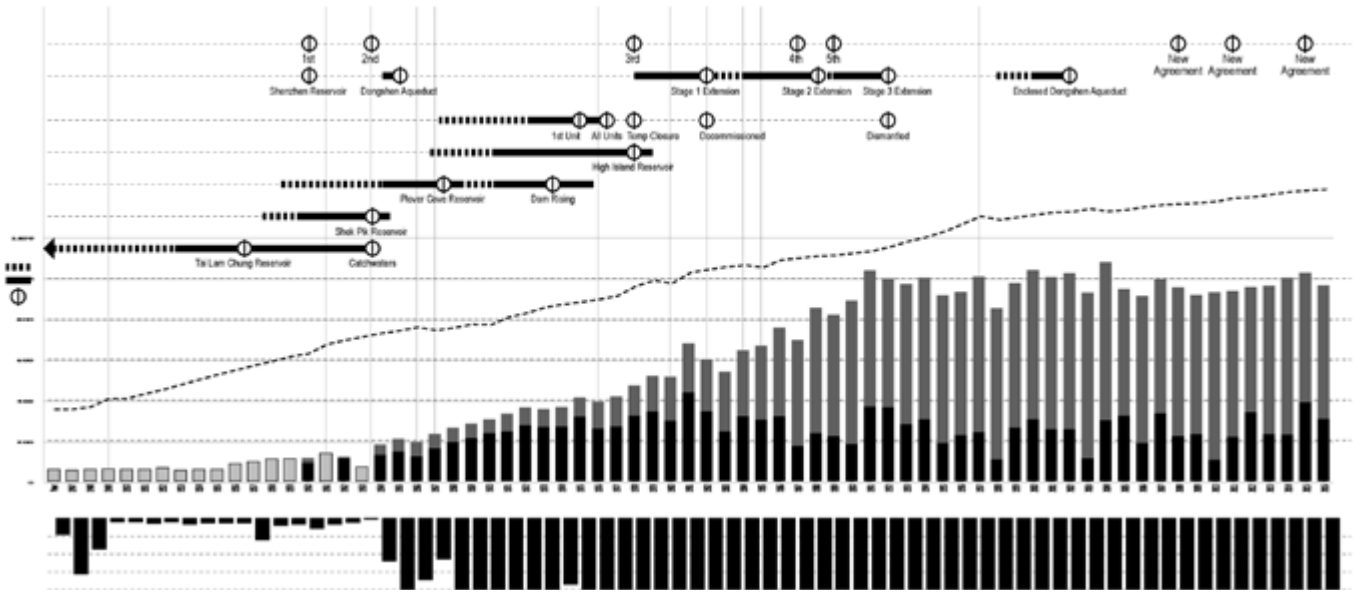

Figure 5.6. Evolution of Hong Kong's post-war water supply. (Illustration by Dorothy Tang. See WSD 1978, 2011; Lee 2014; Liu 2013.)

Dongjiang watershed, and on a refusal to acknowledge the uncertainties introduced by climate change, the geographical shift upstream of polluting industries, and the urban region's growth, with a population of over forty million people (Civic Exchange and ADMCF 2017, 12–14).

In a rebuttal, an official from the Water Supplies Department stated that "unlike Singapore, where water is imported from another country and drastic actions are required to enhance the water security, Hong Kong imports water from her motherland, which provides a higher level of water security" (Chau 2017, 1). He argued that the department does not take imported water for granted, and that it seeks to bolster water security through its multipronged flagship policy. Furthermore, he contended that the 2008 "Total Water Management Strategy" proposed water conservation, infrastructure upgrades, and increasing use of alternative water resources, such as a planned desalination plant in Tseung Kwan O, as well as the use of reclaimed water in the New Territories to meet Hong Kong's needs (Chau 2017, 3). This paradoxical representation of water security relies on an assumed benevolent sovereign Chinese state protecting Hong Kong against the ills of unchecked urbanization in the mainland by enhancing its own infrastructural capacity.

This paradox is also evident in other planning projects in Hong Kong. In 2008, a team of real estate researchers at the University of Hong Kong released a study on reviving large-scale reclamation projects to increase land supply. The team reviewed land policies and land reclamation trends since the nineteenth century, and argued that the only viable solution to land shortage in Hong Kong was continued reclamation. As an example, they suggested the reclamation of Plover Cove Reservoir to provide up to twelve thousand hectares of land (HKU 2017).

This scheme was originally proposed by Frederick Lai, an alumnus of the real estate program at the university and the facility manager for the Bank of East Asia. The underlying assumption was that, with imported water from the mainland, Plover Cove was no longer a critical component for localized water collection, and as an engineered reservoir, it had no inherent ecological value. Reclaiming land at Plover Cove for a new town would not endanger Hong Kong's water security or threaten the marine environment, unlike other proposed reclamation projects in the territory (Hong Kong Development Bureau 2018).

Lai's proposed Plover Cove New Town would house 0.8–1.2 million people on only six hundred hectares of land, and would consist of 300,000 residential units and over 6 million square meters of retail, commercial, institutional, and public space. The total land value generated would be sufficient to fund public infrastructure for mass transit and vehicular access, as well as site preparation. The proposal included a cost-benefit analysis related to water production and storage, as well as

environmental impact. Lai argued that removing the water storage capacity at Plover Cove would not impact water supply quantity or environmental value. However, he estimated that if the water quality of imported Dongjiang water went below a certain threshold, Hong Kong water reserves without Plover Cove would not be sufficient to dilute the pollution. Therefore, the reclamation of Plover Cove would need to occur in tandem with two large-scale desalination projects as a precaution against that contingency (Lai 2018). While Lai's proposal was ultimately rejected in a public consultation process, it illustrates how the contemporary politics of land supply are weighed against the politics of water security in Hong Kong.

Hong Kong's Water Futures

Since 1976, Hong Kong has designated approximately 40 percent of its land as country parks for nature conservation and recreation. The Country Park Ordinance, which took effect shortly before the completion of High Island Reservoir, was originally intended to protect the colony's water gathering grounds, and it covers all the water catchment areas of the territory's impounding reservoirs (Stimpson 1985). The recreational and ecological functions of these landscapes were a secondary concern at the time, but they have evolved into an important resource for Hong Kong's urban residents. However, the value of water gathering grounds within the territory persists in the collective consciousness of the public, despite both perennial land supply shortages and assurances that Mainland China will offset any shortfall in Hong Kong's water supply. Watershed protection remains an important justification for proponents of country parks against encroaching urban development, even though the function of these landscapes long ago shifted from water production to water storage.

The perceived merits of Hong Kong's local water supply infrastructure were borne out of a long period of dissent and controversy, in stark contrast to projects such as Chek Lap Kok Airport or the Mass Transit Railway system that have become de facto symbols of Hong Kong's infrastructural modernity. The colonial government committed significant resources and political capital to localizing water supply infrastructure, yet despite remarkable engineering achievements and technological innovation, it still failed to gain legitimacy. Throughout the post-war period, the government was undermined by the very weather patterns and natural processes that it sought to overcome. Ironically, the public's acceptance of this colonial infrastructure system shifted with changes in sovereignty, and continues after the original infrastructural function of this landscape became obsolete.

Narratives of water scarcity since 1842 have provided technocratic cover to suppress local resistance amid ongoing geopolitical negotiations between Main-

land China and Hong Kong. The water emergencies of the 1960s shaped and solidified opposing narratives of water scarcity with regard to political affinity—one is limited by the political boundaries of Hong Kong and its landscape, while the other extends into the Dongjiang watershed in the People's Republic of China. Each political shift or crisis determines the geographical extent that Hong Kong is entitled to rely upon in order to meet its water demand. The dramatic transformation of Hong Kong from barren rock into a territory of lush, afforested hillsides more than fulfilled the British colonial fantasy of a civilized landscape, as Robert Peckham (2015, 1180) has argued, but it is an infrastructural landscape carefully configured and reconfigured in response to political conflict at various scales. The 2019–2020 pro-democracy protests once again amplified the politics of infrastructural integration and economic reliance between Hong Kong and the mainland, and it remains to be seen what new infrastructural rationales will emerge.

Notes

1. By contrast, New York City is approximately 1,200 square kilometers with a population of 8.4 million people, and only 21 percent of its land is used for parks and recreation (TPL 2020).
2. The Great Leap Forward occurred between 1958 and 1962. In addition to the reorganization of the population into rural communes, the program used labor-intensive and low-tech strategies to increase China's economic output and help it rival the modern nations of the West. The Great Leap Forward was terminated due to a nationwide famine that resulted from the diversion of labor from agriculture to industry and numerous floods and droughts during this period.
3. See Water Supply from China 1960–1986.
4. See Water Supply from China 1960–1986 and Water Emergency 1964–1965.
5. Quoted in Water Emergency 1964–1965.
6. See ibid.
7. See Water Supplies 1965–1968.
8. See ibid.
9. See Water Supply from China 1960–1986.
10. Quoted in ibid.
11. Quoted in ibid.
12. See ibid.

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CHAPTER SIX

Teleview and the Aspirations of the Infrastructural State in Singapore

HALLAM STEVENS

In 1988, Singapore rolled out a pilot for a homegrown digital computer network. Teleview, as it was called, was a videotex system that used the public telephone network to connect paid subscribers to a central computer via a modem. Users could gain access to information about a variety of topics, including weather, stock market prices, and travel. They could also use online banking, business communication, ticket reservation, and educational services, as well as electronic directories, games, and magazines (Keong 1990). Despite significant government promotion of the project, the rate of uptake was slow. Although the cost was low—equivalent to about USD 5.50 per month, plus three cents per message and thirty-five cents per hour of connection time (Sandfort 1993)—only 5 percent of Singaporean households ever subscribed to Teleview (Wong 1997). The system was eventually modified to become a portal through which users could connect to the global internet.

Given this brief account, it is tempting to understand Teleview as a kind of failure—something that was not widely adopted and was quickly displaced once the real thing (namely, the World Wide Web) came along. As a corollary, it is also tempting to read Teleview as some sort of desperate (and ultimately unsuccessful) attempt by an authoritarian government to curtail the democratizing forces that the internet promised to bring with it. Indeed, Cherian George (2012, 216), one of Singapore's foremost media critics, quickly dismissed Singapore's native network: "The Internet's big bang in the mid-1990s turned the likes of Teleview into white elephants and relegated what were grand national projects to mere footnotes in the history of the online revolution."

In this chapter, I seek to rescue Teleview from the footnotes, portraying Teleview not as a failure, but as part of a successful initiative to develop Singapore's high-tech infrastructure for future economic success. Seeing Teleview as part of broader infrastructural investments suggests its symbolic and practical importance in driving Singapore's economy and maintaining the government's political legitimacy. I also develop the concept of paternalistic infrastructure—that is, infrastructure designed to assure citizens that their government is taking adequate care

of their needs and the nation's future. Such infrastructure can demonstrate not only the power, but also the wisdom, beneficence, and foresight of the state.

Even before Singapore became independent in 1965, its leaders saw the development of physical infrastructure as one of the keys to its economic and social development. Of immediate concern was housing: according to one of Singapore's leading planners, 1.15 million Singaporeans (out of a total population of 1.6 million) lived in villages and slums (Liu 2016). To address this issue, in 1960 the government created the Housing Development Board to coordinate a massive effort to plan and construct public housing. Empowered to conduct land acquisition, slum clearance, planning, building, and the management of infrastructure, the board moved rapidly into action, constructing almost forty-five thousand apartments in five years between 1961 and 1965 (Cheong 2016). The breakneck pace of construction continued throughout the 1960s and 1970s, with the government providing a growing number of residents with accommodation linked to running water and electricity.

If housing was one immediate concern, the government also needed to generate employment and expand the economy. In these domains, too, its approach was largely infrastructural. The creation of space and facilities such as ports would attract multinational companies to establish operations in Singapore. Beginning in 1961, Goh Keng Swee, the finance minister, designated Jurong Industrial Estate, a large tract of land in the west of Singapore, for industrial development. Hills there were leveled, and swamps filled in. By the mid-1970s, the site was occupied by more than six hundred factories (Cornelius and Lee 2016).

The government also attended to the development of transportation infrastructure. In 1967, the state began a four-year planning study to generate a comprehensive "Concept Plan" to guide Singapore's long-term urban development. This included the construction of a network of expressways, the renewal of the public bus system, and, eventually, the development of a subway known as the Mass Rapid Transit system (Singh 2016).

Between 1960 and 1990, these infrastructure programs in housing, industrial development, and transportation had completely transformed Singapore's appearance, economy, and society. Both practically and symbolically, infrastructure was central to Singapore's story of modernization from Third World to First. The successes of these projects—in housing the vast majority of the population in public housing, in rapidly growing the economy, and in avoiding the traffic snarls common to other Southeast Asian cities—allowed the government to point to infrastructure as a very visible symbol of its foresight, good management, and beneficence. In other words, infrastructure provided a critical pillar of the government's continued legitimacy in the eyes of Singaporeans.

Infrastructure, then, plays a particular role within Singapore's postcolonial development and politics: it constructs a set of paternalistic relations between citizens and the government, in which the former become the grateful recipients of the latter's technological largesse. The success of infrastructure guarantees secure housing, jobs, and wealth for a sizable majority of the population, and it justifies continued support for the government and its policies. This chapter shows how constructing a digital or computational infrastructure, including a homegrown electronic network, should be understood on the same terms.

Networks and Scale

The history of electronic networking has long been shaped by a focus on one of the internet's most salient features: its global scale. This narrative has emphasized the rise, spread, and domination of the Anglo-American internet. More recent scholarship has begun to examine electronic networks on local and regional scales. These alternative histories of networking include Eden Medina's (2011) work about Cybersyn in Chile and Benjamin Peters's (2016) book about the "Soviet Internet." This development allows for more diverse stories, but it also begins to suggest the manifold affordances and possibilities of electronic networks. Not all electronic networks are global in scale, nor do they necessarily aspire to be; some are shaped by distinctly local contexts.

Most important for the purposes of this chapter is Julien Mailland and Kevin Driscoll's (2017) book about Minitel in France. Minitel was a system that had much in common with Singapore's Teleview. Like Teleview, Minitel was set up by the government and was publicly owned. Like Teleview, it was a videotex service that required the purchase of a specialized computer system and the payment of a monthly subscription. And like Teleview, it ultimately was displaced by the World Wide Web (although Minitel enjoyed a good deal more popularity and longevity than Teleview). Mailland and Driscoll (2017, 150) argue that the distinction between "open" private networks like the Web and "closed" publicly owned networks is a false one: "Today, Internet service providers in the United States argue that only deregulated, privately owned telecommunications networks can promote as well as protect openness and innovation. . . . They suggest that any form of government oversight will doom the Internet. Minitel provides a convenient bugbear for this extreme position. Look, they say, Minitel collapsed because it was regulated! In reality, however, the case of Minitel can be used to argue precisely the opposite point. Public investment and regulation of the Minitel platform did not equal total dirigisme nor did it stifle innovation."

Mailland and Driscoll also note the vast public investments that the United States made in internet research and infrastructure: until 1995, for example, the

backbone of the US internet was owned and operated by the National Science Foundation (and was called the National Science Foundation Network, or NSFNET). In some ways, France and Singapore were copying the US model, rather than trying to do something different.

In light of this observation, Teleview's abbreviated life span can hardly be attributed to a failure of vision or to a botched attempt on the part of the government to control online space. Rather, Teleview's fate has much to do with the rise of a new and pervasive model of private networking that took hold in the mid-1990s. Singapore, like the United States, shifted away from the model of public infrastructure provision in a variety of sectors, making a network wholly run by the government seem less and less economically palatable. Teleview, like the NSFNET, was a victim of this broader transformation. Teleview's demise, however, did not imply the abandonment of the government's vision of maintaining an electronic network that served the public interest (or that of the government). Although Singapore's internet is now privately run and largely uncensored, the government continues to curate and control it in ways that reinforce the government's own legitimacy (Rodan 1998, 2003). The Teleview model of a network that served the government's paternalistic mission persisted long after the network's end.

Envisioning a Digital Singapore

By 1980, Singapore's strategy of export-oriented industrialization had succeeded in growing Singapore's economy and increasing wages. However, to continue to flourish the city-state could not continue to rely on low-wage manufacturing to drive growth; as the cost of labor rose, Singapore would become increasingly uncompetitive. Rather, Singapore needed to move up the value chain, developing industries that would allow it to continue to generate revenue from exports. The burgeoning computer and information technology (IT) industries seemed to offer an excellent opportunity for the development of a high-tech economy.

During the second half of the 1970s, the personal computer industry was just beginning to take off in the United States. At the same time, an industry in developing software for these machines was starting to emerge. In March 1980, Goh Chok Tong, Singapore's minister for trade and industry, appointed a high-level ministerial committee to assess the possibilities for computerization in Singapore. The Committee on National Computerisation issued a report six months later detailing its recommendations, which included the enhancement of computer education in Singapore, the computerization of the civil service, the promotion of the software industry, and the creation of a National Computer Board to oversee these initiatives (Committee on National Computerisation 1980).

The National Computer Board moved quickly to implement these plans, starting with the computerization of the civil service and then moving to the coordination of computer education and promotion of the computer services industry (Teo and Lim 1999). Central to the vision of a digital Singapore was the creation of an appropriately educated workforce. The 1980 committee report had identified a shortage of qualified labor as the most significant roadblock to Singapore's successful development of information technology industries. Moving the nation from a manufacturing economy to a "brain services" economy would require a significant transformation of its population (Committee on National Computerisation 1980, 5).

The need for education and training was underscored in the government's further efforts toward the development of information technology. In 1984, the government convened a National IT Plan Working Committee, consisting of representatives from the National Computer Board, the Economic Development Board, Singapore Telecoms, and the National University of Singapore. Its 1985 report, the "National IT Plan," outlined a seven-point strategy that included the development of both IT infrastructure and workforce training. Particularly significant was the report's focus on IT culture, recognizing the need to prepare citizens for the emerging computerized society (Chia, Lee, and Yeo 1998). If information technology was to become a "new bloodline" for the Singapore economy, an "integrated approach" would be required (National IT Plan Working Committee, 31). In practice, this meant the need to mount an educational and social effort, as well as an economic one, to drag Singapore into the information age.

By the mid-1980s, developing a state-of-the-art information and communications infrastructure was part of Singapore's wider vision for modernizing its economy, workforce, and society. This would be a largely top-down effort, through which the government increased educational opportunities and provided technology for its citizens to provide them with the economic and social benefits of the emerging digital age.

Building Teleview

The 1980 Committee on National Computerisation had paid little attention to networking. But the inclusion of Singapore Telecoms in the National IT Plan Working Committee demonstrated a growing realization that communications infrastructure would be critical to computerization. The committee's 1985 report argued that networking would be the "backbone" of the IT industry, allowing Singapore businesses to sell their services and data overseas. The committee imagined a network linked to Singapore's overseas trade offices that would create a "business intelligence network" and facilitate international market research and analysis of future IT trends (National IT Plan Working Committee 1985, 44).

Singapore's telecommunications industry was managed by the Telecommunications Authority of Singapore (TAS), established by statute in 1972. During the 1970s, TAS closely monitored the developments in networking technology in other parts of the globe and added several new kinds of specialized networking services to Singapore's telecommunications offerings. TAS introduced international automated telex services, telephone-based facsimile services, connections to the International Switched Telephone Network (also known as datel), telefax, radio paging services, and specialized banking, maritime, aeronautical, and meteorological communications systems (TAS 1975, 1985). In September 1978, TAS offered Singapore's first connection to an international packet-switched data network called Telepac. This network offered subscribers dial-in access to computer databases in the United States via the public switched telephone network or via private leased data lines. By 1981, Telepac had forty-six subscribers, a number that jumped to almost six hundred by 1985 (National IT Plan Working Committee 1985, 13). During the early 1980s, Telepac services were gradually extended to more countries, and local databases were also connected to the network (TAS 1985, 35).

More ambitiously, by the late 1970s, TAS was looking forward to a "total telecommunications concept" resulting from the "marriage" of the computer to telecommunications (TAS 1977). Such a network "may be a reality soon," TAS promised in its marketing materials (TAS 1977). In seeking to develop such a network, TAS looked to examples overseas. The immediate inspiration for such a system was the United Kingdom. In 1979, the UK Post Office rolled out a system called Prestel (also known as Viewdata) that allowed users to dial into a central computer using their telephone lines.

The Post Office was eager to adapt and sell this service overseas, and it took steps to make the system capable of displaying other languages and alphabetic systems (*Business Times* 1979). In November 1978, two staff members from the UK Post Office visited Singapore to give a closed-door demonstration of Prestel to representatives of TAS. TAS was interested in whether the system would be suitable for its own purposes: "Telecoms' interest is to find out more at first hand about the latest development of the service with a view to studying the possibility of such or other similar Viewdata service in Singapore" (Lee and Teo 1978). By September of the following year, negotiations between TAS and the UK Post Office were under way (Teo 1979b). In a subsequent visit to Singapore in November 1979, Prestel staff members were able to demonstrate the system not only to TAS representatives but also to members of the public (Teo 1979a).

Ultimately, however, negotiations with the UK Post Office broke down. The United Kingdom was not hiding its ambition to draw Singapore into the orbit of an international information network that would be dominated by British technology. This was likely too much for a nation barely twenty years out of colonial

rule. Instead of importing Prestel wholesale, TAS opted to create its own system. Going its own way would have economic and technological advantages for Singapore: ultimately Singapore could even hope to sell its own system to other nations, just as the United Kingdom was trying to do (*Business Times* 1990b). National pride was also an important consideration: "If others can do it, so can we," the *Straits Times* reported (Khalik 1982).

Like Prestel, Teleview (as it came to be called by TAS) would operate via telephone networks, connecting users to a central computer that would serve data to them via a dedicated device in their homes that was connected to a television. But Teleview was more ambitious than Prestel. Most importantly, Teleview would display color, photograph-quality images. Existing videotex systems, including Prestel, used a graphical system called alpha mosaic, which displayed images in blocks. Goh Seng Kim, the general manager of TAS, argued that such a system would be useless for online shopping since "no one will buy anything based on such childlike drawings" (quoted in Khalik 1985). Since phone lines did not have the requisite capacity for transmitting such data, an alternative would be needed, which significantly complicated the system.

In 1980, TAS issued a closed tender for the development of Teleview. The successful partner would enter into a joint venture with TAS to build the network infrastructure and design computer terminals that could be used as access points in Singaporean homes. The initial plan was for a trial service to be introduced in the 1982–1983 financial year (Khalik 1984). But the complexity of the system significantly delayed the process. Thirty companies had showed an interest in partnering with TAS, and five of them were short-listed in 1981. But none was deemed immediately capable of building the system TAS wanted. "The problem was people (telecommunications companies) didn't have the same vision as us. They thought we were on cloud nine," Goh told the press (quoted in Khalik 1985). Thomson-CSF (the French telecommunications giant) and Marconi (part of the British General Electric Conglomerate that had built Prestel) seemed the most promising. But it took until 1985 before a deal was actually struck between TAS and Marconi. In July of that year, a team of TAS engineers traveled to the United Kingdom to work at Marconi's research and development laboratories (Khalik 1985). The Singaporean government committed SGD 50 million (approximately USD 23 million) to the development of the system and its software.

Making Teleview a reality involved solving three major challenges: developing a network infrastructure capable of displaying photo-quality images, developing consumer hardware for Teleview connections that could be purchased at a reasonable price, and developing the software to run the whole system. The demand

for photo-quality images resulted in a particularly complicated network architecture (figure 6.1).

The central Teleview computer connected to homes and businesses in two distinct ways. First, as in other videotex systems, the computer connected to terminals via the public switched telephone network. Users could dial in, using a

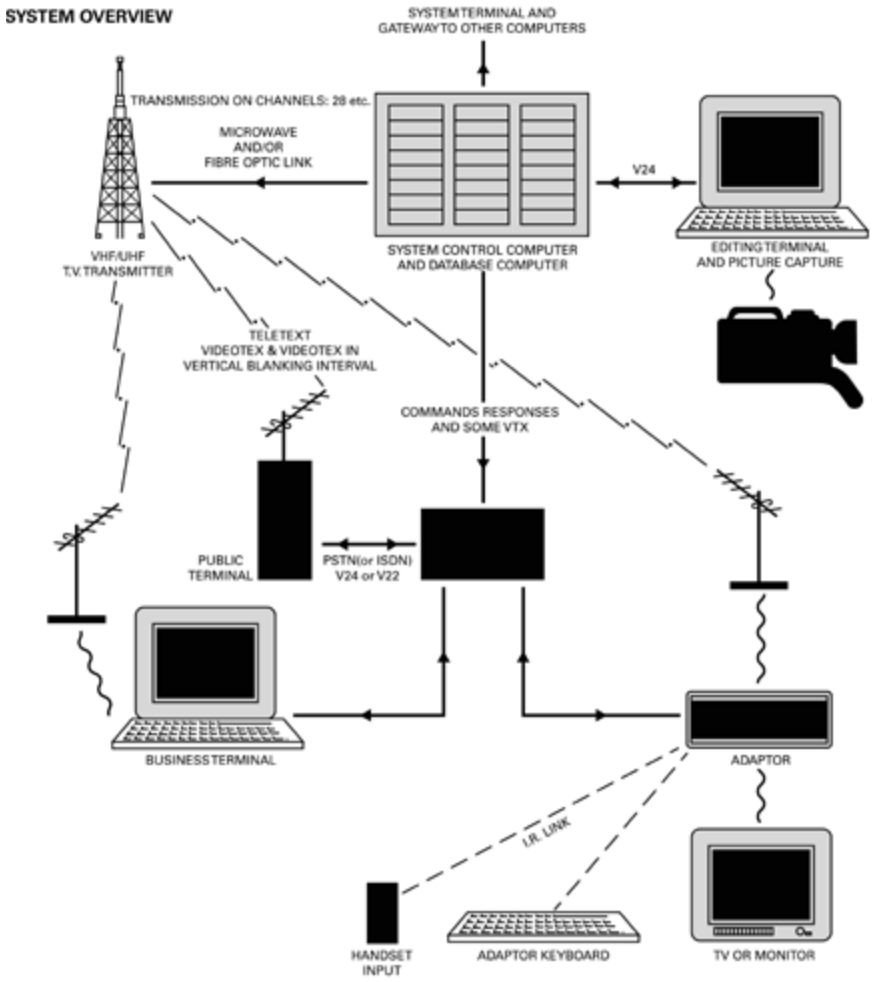

Figure 6.1. The architecture of Teleview. (Illustration by Dorothy Tang, from an original by Trevor Richards and Peter Yuan in *IEE Review* 1991. Courtesy of the Institution of Engineering and Technology.)

modem, to connect their computer or television to the central computer. Second, the central computer was also connected to the Singapore Broadcasting Commission's television antenna. The antenna broadcast Teleview images using a UHF television signal. When a user requested a particular image, it could be received at television quality via their regular television antenna (Keong 1990). This gave Teleview an effective data rate of 5.5 megabits per second, much higher than that of a modem (Richards and Yuan 1991, 261).

TAS also developed several different kinds of computer hardware that would enable access to Teleview. Initially, users could purchase a so-called black box Teleview device that could be connected to a telephone line and paired with a television screen, allowing people to use the service without purchasing a computer. Later, TAS sought to develop a stand-alone terminal with its own antenna, telephone connection, and screen. Finally, TAS aimed to make Teleview available to people who already owned an IBM-compatible PC by creating a Teleview adapter that could be plugged into their computer (Parliament of Singapore 1990).

Although the Teleview system was quite closely based on Prestel, several important modifications had to be made. The network software had to cope with two distinct data sources (telephone line and television signal). The system was also adapted to be able to display Chinese characters. And Teleview developed a sophisticated editing system that allowed service providers (such as businesses wishing to sell products) to capture images and arrange them into a series of frames that could be navigated by users. A business might, for example, create a frame with a photograph of a particular product for sale, as well as information about the product's price and other specifics. The user could then browse this information on screen using pop-up menus and a mouse (Richards and Yuan 1991). All this information was stored in a large back-end database consisting of a set of powerful VAX servers.

By September 1988, Teleview was ready for a field trial. The system was rolled out to 450 home users and 450 businesses, free of charge. To celebrate the successful partnership between Singapore and Marconi, a British company, Prime Minister Margaret Thatcher attended the opening ceremony. She took the opportunity to describe how Singaporeans now had the most advanced videotex system in the world (Chng 1988). Goh Chok Tong, then first deputy prime minister, was also present to offer congratulations: "With our Teleview, Singaporeans can feel proud that we have something even the Swiss do not have yet" (C. Goh 1988, 2). Such pronouncements reminded Singaporean citizens of their government's beneficence in providing infrastructural technologies that would not only be to their direct benefit but would also put Singapore on the cutting edge of digital development.

Government Visions

After a two-year pilot phase, Televiewwas officially rolled out to the public on October 31, 1990. As in 1988, an elaborate opening ceremony was held, where Yeo Ning Hong (1990), the minister for communications and information, stressed the pioneering nature of Televiewand highlighted its accessibility for Singaporeans of all walks of life. It would take, he promised, the average Singaporean only twenty minutes to learn how to use Teleview. His speech imagined not only a nation powered by digital technologies, but also a highly educated and technologically savvy population in which even an average person would be able to benefit from high-tech infrastructure.

Televiewwas designed as a way to bring Singapore into the information age: it would provide banking services, stock and business information, inter- and intrabusiness communications, educational services, electronic directory services, games, government information, magazines, and travel information. The government had high hopes: "[Teleview] will enable all Singaporeans, old and young, to participate in the New Age. It will benefit all of them, each in different ways. It will help our children in their education. It will raise productivity at the workplace. It will also improve the quality of life at home. . . . Televiewjoins the [Mass Rapid Transit system] and Changi Airport . . . as distinct milestones along our path" (Yeo 1988, 2).

In other words, Teleview, like the transit system and airport, was seen by the government as a kind of infrastructure: a platform on which business and government could be more effectively and efficiently conducted. According to Singapore Telecoms (1989), "the Televiewproject is consistent with Singapore's goal of being a total business centre for major companies, and contributing towards a better quality of life by providing new and more useful communication services." But this infrastructure also had a particularly important symbolic purpose: to signal that the government's embrace of technology would secure the nation's future and the well-being of its citizens. This paternalistic infrastructure was designed to reassure Singaporeans that the government would provide for citizens with and through technology.

For example, in the National Computer Board's report, "A Vision of an Intelligent Island" (1992), the case is made for Televiewas part of a "National Information Infrastructure." The report considered the effect of information technology on construction and real estate, education and training, financial services, government, health care, the IT industry, manufacturing, media and publishing, retail and distribution, tourism and leisure, and transportation. Although almost a quarter of Singaporean households had computers, the report noted, only a small fraction of these

were connected via a modem. A "national information infrastructure, like the road network and the utilities networks, is needed to realise the full potential of IT" (National Computer Board 1992, 10). This information infrastructure would be connected globally, integrated into the nation's physical infrastructure, and connected to all homes and offices. Only through high-level planning and integration across agencies, integration across physical and digital infrastructures, and integration between technology, policy, and legal frameworks would the full value of IT be realized in Singapore.

Most importantly, the National Information Infrastructure would improve Singaporeans' quality of life: "It will generate more opportunities and choices in the leisure, kinship, social, work, and civic spheres of each person's life" (National Computer Board 1992, 32). To illustrate its role in the daily lives of individuals, a press release issued with the "Intelligent Island" report told the story of the fictional Tay family using a future iteration of Teleview: Mr. Tay, a tailor, uses a giant wall screen to display shirts to his customers; Mrs. Tay uses Teleview to work at home, shop online, and play mah-jongg with her friends; and their son uses it to get information about bus routes and Singapore's wartime history for a school assignment (Sandfort 1993). Not only is Teleview for everyone, but it reinforces traditional family roles: the breadwinner husband, the homemaking mother, and the son dedicated to his education.

Much of the marketing material for Teleview also centers on the family and the home. One example shows a husband and wife seated side by side in their living room (figure 6.2). The Teleview screen is directly in front of them, next to their hi-fi system and an electric piano. Teleview is portrayed as an indispensable piece of technological furniture for the home. Another image shows a mother and her young daughter gazing smilingly at a Teleview screen placed on a desk (figure 6.3). They hold the Teleview remote together, suggesting that the mother is gently instructing the daughter on its use. With her other arm, the daughter cradles a large teddy bear, and in the background we see a lamp, flowers, and a framed painting. We are transported here into the midst of an intimate family scene—a precious moment shared between parent and child in which Teleview sits at the center. These images, taken from the user's guide published by TAS, reinforce the message that "Teleview is so simple, it's for everybody" (TAS 1988, 3). They depict Teleview as a distinctly domestic technology: one that can reach into the home to take care of ordinary citizens and enhance their lives.

Beginning in 1989, TAS produced a quarterly publication (simply called *Teleview*) for Teleview users to promote the system and update users on what services were available. An analysis of this magazine also suggests various ways in which Teleview was oriented toward the extension of government services into

Figure 6.2. Teleview users in their living room. (Photograph by TAS, 1988.)

Figure 6.3. A mother and daughter using Teleview. (Photograph by TAS, 1988.)

communities, families, and the home. The front page of an issue from 1993, for example, details the "Community Link" features of Televiewe, particular services directed toward elderly and vulnerable citizens: "Sign up on the spot through Televiewe to be a volunteer with the National Council of Social Services. Send your pledges under NCSS on easy donors page *410200045#, using your credit card" (TAS 1993a, 1). Services provided through Community Link included a poison information center, IT forum, health line, AIDS forum, feng shui advisory, and a counseling service, as well as services for the elderly and for pregnant women. Televiewe aimed to become, in the vision of Goh Chok Tong, a "personal line to government," allowing "a line of communication from your home to the Government and back so you can find out more about policies and issues—and give your views on them" (quoted in K. Goh 1988).

Although Televiewe (and the magazine *Televiewe*) prominently featured stock prices, educational services, and games, a great deal of emphasis was also placed on highlighting how citizens could use the service to access information about public housing, the national pension program, and the government's automobile licensing program. The integration of Televiewe with the Housing Development Board was of particular importance. The magazine featured stories about Televiewe's rollout into various housing estates and about the increased provision of housing-related information, such as property listings and home loan information (see, e.g., TAS 1991, 8). In other words, one of Televiewe's roles was to promote and enhance engagement with the state's most important sources of welfare: housing and pensions.

The link between Televiewe and Singapore's other major infrastructures was also evident in *Televiewe* magazine. In 1993, the magazine featured a full-page photograph of the air traffic control tower at Changi Airport, alongside a discussion of air travel–related services provided by Televiewe. These included not only flight arrival and departure information, but also an airport directory and an air freight database (TAS 1993b, 4). Linking Televiewe to Changi enhanced the value of each, and it brought Singapore's high-tech aviation and port infrastructure into living rooms and offices.

Gregory Clancey (2012, 21–22) has argued that the values built into Televiewe were "social unity and cohesiveness"—that Televiewe was part of an attempt to create a more unified national polity. There is no doubt that part of the government's aim was the creation of community ties. But more broadly, the government aimed to create an infrastructure that would enhance the daily lives of all citizens by providing a literal and symbolic link between people's living rooms and government-provided services like housing, social welfare, and transportation. Televiewe was a technology through which the government could look after people from within the intimate confines of their own homes. This entrée into the family made Televiewe

a powerfully paternalistic force, informing and guiding citizens literally in their own living rooms and bedrooms.

Public and Private Networks

Despite the coherence and pervasiveness of the government's vision for Teleview, its development was neither unproblematic nor uncontested. Indeed, as Teleview was rolled out, Singaporeans both inside and outside the establishment became increasingly concerned about the role that the public sector was playing in IT. In particular, there is some evidence that the government was aware of the potential problems of building a network from the top down.

The construction of Teleview, like that of the Mass Rapid Transit system, was not undertaken lightly. Even though Teleview's price tag was much lower than that of the transportation system, individuals both inside and outside the government voiced caution about various aspects of a national electronic communication network. For one thing, some people worried that there would not be sufficient demand for such a network. In a letter to the *Straits Times*, Phillip Lim (1985) argued that the "common person" might not actually need or want Teleview. Citing uptake figures from France, the United Kingdom, and Germany, Lim noted that most of the users of similar networks in those countries were businesses, not ordinary people: "The fact that Videotex has not taken off in the developed countries even after a decade might indicate that public sector initiative is not enough. A clear need for its use must be there, and users must want to use the services." Lim was challenging the notion that such a network could or would serve the public good. If only businesses or members of the elite (rather than common people) used it, then the network would not be fulfilling its purpose.

TAS responded to such criticism by reiterating the fact that Teleview would be a more advanced and appealing system than those in the United Kingdom or France. It also endeavored to ensure that costs to the user would be kept low and that the system would offer services that ordinary citizens would want and use (Parliament of Singapore 1989). But this careful top-down planning was also a source of concern and debate. In 1990, just as Teleview was being publicly launched, Philip Tan Tee Yong, a member of Parliament, questioned TAS's decision to use a government-owned company, Chartered Electronics Industries, to build the Teleview terminals. Yong asked if this was not inconsistent with the government's aim to make "the private sector be the engine of growth" (Parliament of Singapore 1990).

Such criticism was echoed in public forums. After an article in the *Business Times* suggested that selling Teleview terminals "would make the statutory board a major computer vendor in Singapore," TAS felt compelled to write an extended

clarification explaining that it did not aim to compete with private companies in selling hardware (*Business Times* 1990a; J. Goh 1990). The public also complained that TAS seemed to be creating a monopoly for itself: "Telecom has a monopoly on the medium. Does it want a monopoly on the software and hardware too?" one disgruntled customer demanded (Ng 1991). One newspaper op-ed put the problem very bluntly: "In an open and competitive market, market forces are likely to push the course of action through the demand generated for services at the right price. Here in Singapore is a monopoly where decisions can be taken by technocrats enthusiastic about new innovations and spurred on by the political will to drive at new directions in top gear. There are pitfalls in both approaches" (*Business Times* 1985).

The late 1980s was a period of shifting attitudes toward government service provision, both globally and locally. In the West, the policies of Prime Minister Margaret Thatcher and President Ronald Reagan led to privatization of infrastructure such as utilities and public transport. In the 1990s, the Singaporean government also began to move toward greater economic liberalism and greater scope for the free market, privatizing telecommunications, utilities, and the port (Chua 2017, 110–111). In this environment, Teleview's champions knew that they had to steer clear of competing directly with private companies. Rather, their aim was to create infrastructure that would underpin business development and economic growth. Government action would solve what Goh Seng Kim saw as a "chicken and egg" problem: users would not pay to join a network without services, but businesses would not offer services without users to offer them to (quoted in Yap 1985). Teleview attempted to jump-start online activities by providing public services that people would want.

But the biggest problem for Teleview was that not many Singaporeans signed up to use it. TAS used several strategies to attempt to prime user interest, offering heavily discounted modems and offering free trials in schools. According to one report, this latter strategy cost Teleview more than half a million Singapore dollars (about USD 350,000) in losses (Mok 1995). In December 1994, in a further move to encourage interest, Teleview added a portal through which subscribers could connect to the World Wide Web (Tong 1995). But this was hardly sufficient. In 1995, Teleview had 33,500 subscribers (a 120 percent increase over the previous year) and was garnering fifteen million frame views per month. But the number of subscribers amounted to less than 5 percent of households. By this time, other providers (including TAS's own TechNet) were offering internet access more cheaply than Teleview was, and the service was losing money.

Why was Teleview unpopular? It is tempting to attribute its failure to bad timing—Teleview didn't have sufficient time to gain a foothold before the World

Wide Web emerged—or to an overly cautious approach to electronic networks on the part of the Singaporean government. My analysis, however, suggests that such an account makes little historical sense: Singapore was in fact following, and improving upon, cutting-edge networking technologies developed in the United Kingdom, France, and elsewhere. A publicly operated network made a great deal of sense, not just for Singapore but for other countries, too. Why should Singapore have predicted the rise and benefits of a private internet when others elsewhere also failed to do so? Nor was there was a general lack of enthusiasm for technology or for electronic networks in Singapore: numbers of connections to the internet were beginning to grow rapidly by the mid-1990s. There is also no evidence that the aversion to Teleview was due to Singaporeans finding it politically or socially restrictive.

Rather, the debates described above suggest that by the 1990s, Teleview was perceived as economically restrictive. A public network symbolized government interference in the IT sector that Singaporeans were uncomfortable with. Singaporeans both inside and outside of the government adopted the view that IT and networks should not be run by a government monopoly. This attitude was congruent with the shifting business model for infrastructure provision and electronic networks in other parts of the world, especially the US privatization of NSFNET. As noted by Cheah Cheng Poh, Singapore Press Holdings' head of electronic publishing, "[Telecoms] need to re-look their strategy in the same way that US on-line service providers such as America On-line and Prodigy have had to do" (quoted in Mok 1995). In other words, it was not just Teleview that was in trouble—the privatization of the internet in the mid-1990s was putting pressure on businesses elsewhere, too.

In 1992, TAS was incorporated as Singapore Telecommunications Limited (SingTel), a company majority-owned by Temasek Holdings (itself owned by the government). Increasingly, Singapore's infrastructure was run under a model that Chua Beng Huat (2017, 118) has called "state capitalism," in which state-owned enterprises are "disciplined by market forces." Within this structure, Teleview became an increasingly awkward relic of an older style of public infrastructure provision. It was not so much that Teleview had failed to deliver, but rather that the economic model for infrastructure provision had been transformed. Instead of Teleview's being a "victim of the explosion of cyberspace," as one article put it (*New Paper* 1998), it was a victim of a privatized model of how digital networks should operate. This suggests a shift in the model of paternalistic infrastructure, since neither the state nor its citizens were very comfortable with direct government provision of infrastructure and services. However, this did not mean that paternalistic infrastructure disappeared entirely. Despite increasing levels of privatization

or pseudoprivatization, infrastructure development has continued to be closely tied to the government's actual and perceived role in caring for its citizens.

Conclusion

In 1993—in the same issue where William Gibson's (1993) article had called Singapore "Disneyland with the Death Penalty"—*Wired* magazine published a report on Teleview: "Teleview and the proposed NII [National Information Infrastructure] are bringing Singapore to a perilous crossroads in its social and political evolution. Singapore has the choice of either creating a truly open international data highway, or perpetuating the narrow, censored flow of information that has served it for nearly 30 years. Once the NII throws open the ideological windows, Singapore's peculiar brand of control may well not survive" (Sandfort 1993).

For the libertarians of *Wired* there seemed to be only two options: allow open access to information via technology and become more politically liberal, or reject "open" technology and retain control. However, this is a remarkably impoverished view of the possible alternatives afforded by electronic networks. It is a view shaped by the "California ideology" of the internet as a utopian zone of democracy, free speech, and technological liberation (Barbrook and Cameron 1995).

Through Teleview, Singapore's government aspired to create a society that was technologically advanced but in which the state continued to play a dominant role in citizens' economic, political, and social lives. As public infrastructure, Teleview was a way to enhance the government's power and legitimacy while simultaneously providing many of the economic and social benefits of electronic networking. Indeed, these goals complemented one another: through the development of a cutting-edge digital infrastructure, citizens could be reassured that the government was looking after them. Like Changi Airport, the Mass Rapid Transit network, or the expressway system, Teleview represented the fulfillment of the government's promise to its people.

In the 1980s, when the users and uses of electronic networking were uncertain, government support for such a technological leap made a great deal of sense. As with other forms of physical infrastructure, government investment would prime the pump for increasing the number of users and improving economic viability. In the 1990s, increasing enthusiasm for privatization of infrastructure provision, both globally and locally, substantially altered this calculus. In the United States in particular, there was a steady transition from public to private provision of networking infrastructure. This was partially because it was increasingly clear that there was a commercial demand for networking services.

But the shift in Singapore from the local Teleview to the global internet did not mark a pronounced shift in the government's attitude toward networking. The end of Teleview hardly spelled the end of government involvement in or oversight of electronic networking in Singapore. Nor did it spell the end of the government's vision of a network to serve the public interest. TechNet and its successor SingNet (both connected to the global internet) continued to offer networking services to Singaporeans, now under the auspices of the nominally private but majority-government-owned SingTel. The Singaporean government has continued to regulate and curate electronic networks as spaces that first and foremost should serve the public good.

This suggests that the top-down approach of Teleview had significant long-term consequences for the uptake of networking in Singapore. Commentators, including George (2005), have long noted a paradox associated with networks in Singapore: despite Singapore's extraordinarily high internet penetration rate, levels of political opposition and civil society organizing online remain consistently low. But this is a paradox only if we assume that electronic networks are intrinsically linked to democratic and free expression. Teleview offers a counterexample: it was a network designed and implemented not for freewheeling expression, but for binding citizens more tightly to their government. Garry Rodan (2003, 504) has argued that the internet is an example of how "the operations of new electronic media can be accommodated to authoritarian rule in Singapore." A combination of mechanisms for monitoring, moderating, licensing, and promoting pro-government content has ensured that the internet has remained a relatively weak oppositional or democratizing force (Rodan 1998). Perhaps the most enduring legacy of Teleview is this vision of electronic networks (even private ones) as a public service. Although Teleview has disappeared, the view of a network as a paternalistic infrastructure may have persisted.

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PART III

Networks

CHAPTER SEVEN

From Creation City to Infrastructural Urbanism

The Chinese National New Area as an Infrastructure Space

TIM OAKES

Gui'an New Area was established in 2014 by China's State Council as part of a broader strategy to jump-start the economy of southwest China's Guizhou Province. The New Area was meant to serve as a demonstration site for eco-urbanism, and as a new service center for China's big data computing industry. That same year, Guizhou was designated as the country's first Big Data Comprehensive Pilot Zone. With an initial surge of investment from the provincial government, transfers of funds from the central government, and favorable tax incentives, Gui'an was meant to become a sort of southern Chinese Silicon Valley: a hub for innovation in artificial intelligence and virtual reality software development. President Xi Jinping visited Gui'an in 2015 and outlined a trio of development objectives that are displayed on signs and billboards throughout the area: "high-end production," "environmental sustainability," and "intensification of economic opportunities on all levels." Covering 1,800 square kilometers (more than twice the size of Singapore), the New Area is a vast stretch of land between the provincial capital of Guiyang and the city of Anshun. Gui'an contains some of the richest and most productive agricultural land in Guizhou, a province where chronically low agricultural productivity (due to the stony karst topography) has historically been the norm. In a place where opportunities for wealth have always been associated with leaving the villages and fields, Gui'an's promise of economic development begins with the simple fact that most of this vast region will be converted to nonagricultural uses. It also means that Gui'an will become a new kind of space, one in which new infrastructure is not only the means of development, but also development's objective.

In one sense, Gui'an is just one manifestation of a broader spatial reordering aimed at facilitating urbanization as the engine of development in China (Ren 2013; Hsing 2010). This reordering essentially positions cities as entrepreneurial growth machines (Wu 2015). But in another sense, Gui'an marks an important shift in the way urbanization is happening in China. In this chapter, I explore this shift by considering Gui'an as an infrastructure space. This concept was proposed by the architectural theorist Keller Easterling, in her 2014 book *Extrastatecraft*, as

a way to identify spaces (such as special economic zones and export processing zones) where governance is driven by the logic of infrastructure provision. Easterling's approach suggested a reconception of the zone format as a space defined less by the formal state administrative systems by which such spaces are designated, and more by the infrastructural assemblages that collect there. Easterling was particularly interested in how infrastructure space has come to define a new urban format. Infrastructural configurations, she argued, have displaced formal planning and design to become the basis for "the urban structure itself—the very parameters of global urbanism" (Easterling 2014, 12). While much of Easterling's concept overlooks the central role of state planning and territorial administration in China, infrastructure space nevertheless offers an intriguing perspective from which to consider the changing nature of urban agglomeration in China, where the differences between rural and urban have become blurred, and where everyday life is increasingly shaped by and lived through so many infrastructural grids.

I suggest that viewing China's new urban developments (like Gui'an) as infrastructure spaces moves us beyond the urge to understand them as cities. An infrastructural approach reveals how urbanization in China has shifted from a city-centered entrepreneurial growth model to a sprawling landscape of grids sprouting up on the edges of and in between established urban centers. At the same time, such an approach puts into sharp relief the way urban developments like Gui'an continue to be invested with a powerful ideological discourse, in which new urban developments are viewed as redemption cities: spaces where China's past urban failures will be set right, where a teleology of progress and civilization finds its apex, and where the social stability and harmony of Xi's China Dream are materialized for all to experience (Oakes 2019). Thus, even as the process of urbanization has changed in a way that renders the city analytically indistinguishable from the countryside, the conception of the city (and, by extension, that of the countryside) continues to shape urban development in significant, if contradictory, ways.

Gui'an, then, is both an infrastructure space and an ideological model that does not quite align with that space. In this chapter I follow the infrastructure to tease out the contradictions between the space and the model. I do this by first describing the infrastructural grids that anchor the New Area. I then offer a brief historical account of what I call China's infrastructural urbanism. This is a term that I borrow from architectural history to highlight how an infrastructural approach to China's modern urban history reveals key continuities across several eras of urban development. Those continuities suggest, on the one hand, a history of friction between the processes and spatial practices of urbanization and, on the

other hand, efforts of planners and other state actors to use those processes and practices to promote certain developmental and modernizing agendas. Examples of these state planning efforts are then discussed in the context of Gui'an. I construe these efforts in scalar terms as a view from above, in which Gui'an is imagined as an exemplary model and "creation city." The remainder of the chapter counters this planner's view from above with a description of Gui'an at the level of the street, where particular spatial practices emerging from both infrastructural configurations and ideological projects are redefining urbanization in China. These spatial practices offer an alternative scale at which to understand China's urbanization experience—one defined less by the administrative space of the city and more by the infrastructure that grids the land into a geography of networks and nodes.

This chapter is based on research that I carried out during several visits to Guizhou in 2017–2019. The research consisted of interviews with local officials, planners, and scholars, as well as ethnographic fieldwork, in Gui'an New Area.[1]

Gridding the Land

A series of grids shapes Gui'an as an infrastructure space. The most prominent of these include a network of new multilane avenues and highways that crisscross the core of the New Area (figure 7.1); new drainage infrastructure meant to channel rainwater runoff throughout the built-up areas; and surveillance and security infrastructure, including ubiquitous CCTV and cameras equipped with facial recognition capabilities. The public security devices are meant to complement a grid of "smart-city" technologies that aim to turn the New Area into a vast data-generation tool—a smaller-scale version of what China hopes to develop on a national scale.

It is the layout of very wide and mostly empty avenues, boulevards, and highways that most viscerally establish a landscape of newness in Gui'an. An incongruous grid pattern of roads has been set down among the undulating hills and valleys of the New Area's core section. The grid consists mostly of municipal-level roads (城市道路), but it also includes arterials (城市干线路) and expressways (城市快速路).

This transportation infrastructure—categorized as "urban" (城市级)—has not augmented the previous rural system of county, township, and village roads so much as ignored it. The new urban grid of roads creates an entirely different space. Whereas rural settlements were previously linked in a dendritic hierarchy of roads and lanes linking market towns to villages and villages to fields, they now occupy uniform and equivalent spaces within a grid network. Local residents are largely

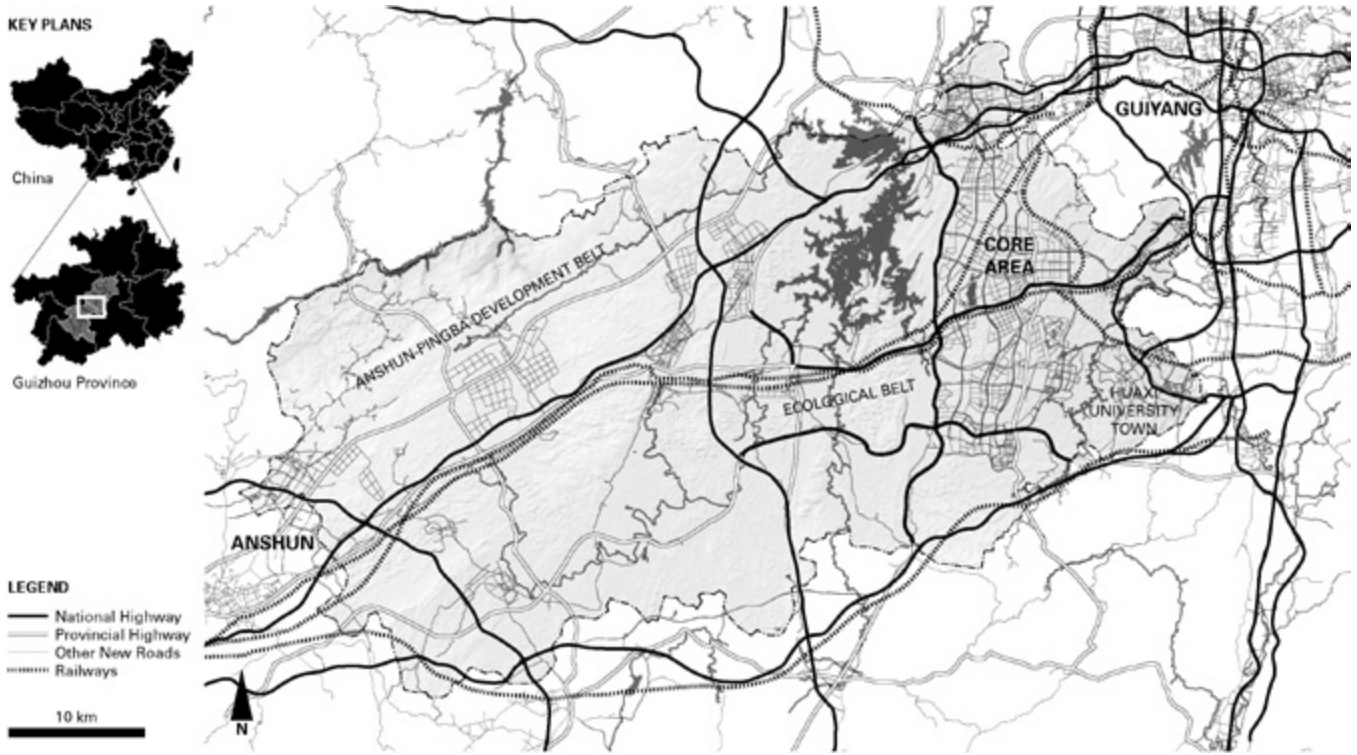

Figure 7.1. Gui'an New Area transportation grid. (Map by Dorothy Tang and Angus Oakes. Made with Natural Earth, Open Street Map, and NASA JPL data. See NASA JPL 2013.)

left to themselves to figure out a way to tap (or hack) into and make use of this new network of roads. The roads partition the land into separate blocks, often turning administrative villages into disconnected parts. In this new landscape, nearby places become distant, separated by ten-lane divided boulevards, while at the same time becoming closer to distant urban centers (figure 7.2). Villagers who hack into this grid with their own hastily built and potholed connectors (sometimes cutting directly through the new roads' guardrails) gain a new level of connectivity on a much larger scale, but only by appropriating a network that was seemingly not built for them.

The New Area is also engineered as an ecological grid, most directly materialized in drainage infrastructure. In 2015 Gui'an became one of sixteen so-called sponge city pilot sites around China. In Gui'an, roughly seventy-five projects were initiated to build roads, parks, and water-treatment facilities with permeable materials, accounting for an estimated investment of over USD 1 billion (Gui'an New Area 2017). The sponge city was a new urban design model proposed by Xi in 2012 after a series of floods devastated several Chinese cities. The model is intended to be an alternative to the conventional engineering practice of moving rainwater through pipes and drains: it creates spaces within cities that absorb rain like a sponge. In Gui'an, seventy monitoring stations were installed to collect data on rainfall use, water levels, and river systems. These monitoring stations demonstrate the expectation that Gui'an should function as a data-collection device as well as an engine of economic development in a relatively poor region of China. The gridding of the New Area might thus be thought of as a transition from landscape to datascape.

Becoming a fully gridded smart city is perhaps the most obvious aim of this transition. The New Area is a key experimental site for the development of so-called Sky Net technology, with the government touting the saturation of Gui'an by surveillance infrastructure. Even the Western media have been impressed. In a 2017 experiment, the BBC journalist John Sudworth tested the area's real-time pedestrian detection and recognition system by trying to make a thirty-minute drive from the New Area to the Guiyang train station undetected by police monitors (Zhao 2017). He was detected after seven minutes, and by the time he reached the station, local police had been alerted and were waiting for him. Sky Net identifies the age, gender, and clothing of pedestrians and drivers through surveillance cameras on the streets. This makes Gui'an a pilot zone not only for remote policing via digital surveillance, but also for algorithmic governance, whereby vast amounts of social media–generated behavioral data (which are increasingly being stored in servers also located in the New Area) are used to manage a whole range of administrative, economic, and security operations. Anticipating Gui'an's pioneering

Figure 7.2. A ten-lane road in Gui'an New Area. (Photograph by Tim Oakes.)

role in developing the "internet of things," one study claims that by 2030, there will be 40–50 smart terminals in every household in Gui'an, each producing twenty terabytes of data every year. The data, it is claimed, will drive output value in Gui'an to over USD 35 billion (Nie 2019).

Infrastructural Urbanism in China

In architecture and design fields, infrastructural urbanism was a response to the semiotic and representational excesses of postmodernism's "architecture of surface." It advocated a return to material instrumentality in architecture, as opposed to symbolism (Allen 1999). As a description of recent patterns of urbanization, however, infrastructural urbanism in China differs from this return to the material practice of Euro-American architecture. In China, a new kind of urban agglomeration driven by large-scale gridding can be seen in New Areas like Gui'an. Infrastructural grids produce not so much cities as networks and operational landscapes, within which new forms of settlement, economic activities, and governance take shape. In many ways, infrastructural urbanism marks a process of urbanization in which urban agglomerations emerge less in response to master planning or administrative policies (which often come ex post facto) and more in response to infrastructure expansions, extensions, and provisions that contain no particular vision of the future city.

To make a provocative claim, one might argue that even prior to the current pattern of urban agglomeration, infrastructure preceded any notion of the city as a distinct space in China. This is because the traditional walled city in China was not a distinct legal or administrative entity; there was no Chinese equivalent to the autonomous city of medieval Europe. Governance in China was scaled as local, regional or provincial, and imperial, but not as urban. The walls surrounding cities did not typically demarcate a spatial-administrative boundary. Walled cities did not have their own particular government structure distinct from that of the administrative territories within which they were located. Rather than marking a spatial divide, walls materialized the imperial order at the local scale. Some scholars have likened the walled city to the nucleus of a cell (see, e.g., Knapp 2000).

Jun Zhang (2017) has argued that modern city governance and the idea of the urban in early twentieth-century China emerged in part when city walls were demolished and replaced with streets. In her study of Republican-era Guangzhou, she traces the emergence of a new urban form made possible by infrastructure projects, and shows how new forms of governance regulating residents' behavior became necessary in the new street spaces created by these projects. Guangzhou's old city walls offered the most obvious sites for new streets and the modern forms of circulation they would bring. Their demolition marked, both materially and symbolically, the transformation of imperial space into modern urban space. Zhang (2017, 168) comments that in premodern China, the urban "was not a category that organized things and people in the Chinese imperial order. But with the collapse of the imperial court and the effort to establish a nation-state, a form of urban governance gradually emerged. The purpose of such governance was to manage the population and goods on the territory that was categorized as urban. From the very beginning, the category of urban was constructed in a way that spoke to a political agenda beyond the urban itself. It was an integral part of the nation-state building and of a modernity project." Crucially, it was through the requirements of modern infrastructure construction that this new category of the urban was materialized and brought into governmental being: "The streets projects were not only products of, but they also fostered, the emerging category of the urban. The streets provided the concrete material and the built environment for the imagination and understanding of the urban, or the modern city" (168).

Like Zhang, Michel Foucault was also interested in how replacing city walls with streets engendered new forms of urban management, new conceptions of the city, and new governmental apparatuses for security and surveillance. Referring to European towns of the eighteenth century, he notes that an important problem "was allowing for surveillance, since the suppression of city walls made necessary by economic development meant that one could no longer close towns in the

evening or closely supervise daily comings and goings" (Foucault (2004, 30). Both Zhang and Foucault, then, anticipate the way infrastructural grids reshape the social orders emerging from urban agglomerations. A century after Guangzhou's walls were demolished and replaced by a modern streetscape that fostered a distinct spatial conception and experience of the urban, infrastructure continues to propel urbanization in China.

This is not to say that urban planning was not a factor in the development of urban spaces over the twentieth century. Indeed, the infrastructural urbanism identified by Zhang's account of the emergence of modern Guangzhou was matched by efforts among early twentieth-century urban planners in China to create model cities set apart from existing urban centers, where state-of-the-art planning practices could be employed (Wu 2015, 16). But such plans were almost never implemented. In the 1920s and 1930s, resources were simply too scarce. And during the 1950s, initial plans for building new socialist cities were interrupted and ultimately subsumed by the state's prioritizing rapid industrialization at all costs. The 1950s emphasis on transforming urban centers into industrial producer cities meant that many of these comprehensive urban plans were never implemented, either: "While the discourse of socialist city planning was to create a new built environment—the socialist city—to shape a 'new socialist man', in reality, the weak economy and the stress on 'productive' industrial investment meant that large-scale new town development was difficult in China" (Wu 2015, 38). This remained the case during the 1960s and into the 1970s, when most urban planning programs in China were shut down entirely as a result of the Cultural Revolution. To an extent, socialist urban planning during this time was defined by the highly constrained infrastructure of China's existing urban system.

During the early 1980s reform era, rural restructuring stimulated a rapid process of rural urbanization. This Township-and-Village-Enterprise-driven process could be understood as a vernacular form of infrastructural urbanism, in which new agglomerations emerged virtually overnight, unplanned and largely informal. These "instant cities" (Hessler 2007) grew up around the infrastructure of production and assembly—makeshift factories in rapidly plotted and often illegal industrial zones—that characterized the early phase of peri-urban and rural development, particularly in China's coastal provinces like Jiangsu, Zhejiang, Fujian, and Guangdong. But, as Xuefei Ren (2013, 25–30) argues, this trend of "urbanization from below" shifted to a policy-driven "city-centered urbanization" in the 1990s and early 2000s, as Beijing responded to the chaotic proliferation of zones with a significant program of retrenchment. This shift was complemented by the success of China's special economic zones and the government's subsequent

designation of fourteen Open Cities along the coast, followed by the establishment of Pudong as China's first National New Area.

In Guizhou, by 2010 city-centered urbanization had led to a trend of developing peripheral new towns in many cities throughout the province, particularly at the county level. Such urban projects were often characterized by the construction of an entirely new city center with large-scale public facilities, including parks and plazas. The most prominent of these was Jinyang New Area (now renamed Guanshanhu District), on the northern periphery of Guiyang. As happened throughout China during this period, municipal government offices were relocated to the New Area in an effort to rapidly populate the otherwise empty streets and apartment buildings. University branch campuses were also opened, along with numerous high-end residential compounds, leisure resorts, and even a theme park devoted to ancient Guizhou culture. Throughout China, the rapid overbuilding of these New Areas and districts contributed to the infamous ghost town phenomenon, while the devotion of government officials to spectacular architectural designs and ornately figured buildings—whose central purpose seemed to be little more than drawing attention to themselves—led to the popular criticisms that China was building "a thousand cities, all with the same face" (千城一面), and that such developments were little more than "face projects" meant to ensure the promotion of the officials who initiated them.

Jinyang might be viewed as one example of the kind of entrepreneurial growth-machine urbanization—what You-tien Hsing (2010) called "the urbanization of the local state"—that seemed to spin out of control during the early 2000s. It became common to see references (both in popular media and in academic accounts) to China's "urban sickness" and to "irrational" urbanization (Woodworth and Wallace 2017). By the beginning of the Xi administration, the central government was issuing prohibitions against the building of new lavish municipal government structures, followed by broader restrictions on new town development. In 2014 the administration even condemned "weird" architecture in an effort to douse local officials' enthusiasm for iconic buildings by which to promote themselves and brand their new town developments (Li 2014). While urbanization remained the government's primary tool for economic development, a different model was clearly needed.

This set the stage for the government's New Type Urbanization Plan, launched in 2014. The plan coincided with the emergence of a new pattern of infrastructural urbanism, in which the priority shifted from city-led urbanization to the construction of a comprehensive nationwide transportation and communication network that linked large regional urban clusters. While this new pattern was not

an explicit policy objective, it can be understood as a response to the plan's aim to spur urban-rural integration, as well as to tamp down the local state's enthusiasm for entrepreneurial urbanization. There has thus been an effort to shift away from hypertrophic expansion of existing urban centers. This shift has resulted in a decreased emphasis on the hierarchical nature of city-centered urban development, and an increased focus on the use of a flattened, more diffuse surface of infrastructure-driven urbanization. As one study of urbanization in the Zhengzhou-Kaifeng region of Hebei has suggested, large-scale infrastructure development throughout the region has uniformly taken over the land. Infrastructural gridding has creating an "equipotential surface" aimed primarily at spreading opportunities for income generation by reducing discrepancies between different parts of the territory, resulting in a "syntrophic territory"—that is, "a territory that tends to be ever more orderly within its confines and differentiated in its components" (Ramondetti 2020, 32). Francesca Governa and Angelo Sampieri (2020, 375) refer to "infrastructuring," where new urban developments like Gui'an alleviate the "hyper-concentration" of central cities and mix rural, urban, and suburban spaces into a discontinuous whole.

The willingness of the state to invest heavily in large-scale infrastructural grids that overlap with and displace existing surfaces has contributed to this infrastructural leveling. At the same time, there has been a significant commitment to developing sets of uniform standards, particularly for eco-city and smart-city development. Eco-city pilot projects must meet sixty-one performance indicators laid out by the Ministry of Housing and Urban-Rural Development's Eco-City Assessment and Best Practices Program (Williams 2017). Standards like these drive performance criteria for each territorial section of the newly gridded space, making each section "equivalent and interchangeable" as long as it meets the criteria (Ramondetti 2020, 110). This has the effect of organizing territory along the lines of logistical principles, while aiming to turn cities into open resources for responsive technology systems.

Gui'an from Above

The infrastructural urbanism that has driven the establishment of New Areas like Gui'an as a response to and correction of what some have called the "sickness" and "irrationality" of excessive city-centered urbanization (Woodworth and Wallace 2017) has, paradoxically, been accompanied by a policy and planning rhetoric that remains invested in a discourse of the city as a distinct, civilized, modern, and socially harmonious space of redemption. I suggest that this discourse is ideological, and that it rests upon an ongoing faith in the promise of a utopian "creation city"

capable of curing all the ills of urbanization. This is paradoxical because infrastructural urbanism has been busy obliterating the city as we know it, replacing it with what Neferti Tadiar (2016, 62), in a different context, has called "uber-urbanization," which "entails continuous and expanding subsumption of life beyond the fixed geography and time metrics of 'the city.'" This is perhaps why the city must be shored up, ideologically, with a utopian narrative that serves the political project of maintaining the authority and legitimacy of the party-state. As Kees Doevendans and Anne Schram (2005) noted, the creation city was one of the three urban archetypes proposed by the architectural theorist Bruno Fortier. Fortier's creation city was purely ideological and purely geometrical, and—like Gui'an's incongruous grid of roads—had no inherent relationship to the environment within which it was built.

A rhetorical version of the creation city clearly informed the ways in which urban planners and municipal officials articulated the ideas driving the development of Gui'an New Area. They referred to Gui'an as a new kind of city, the kind that could only be built from scratch. This is summed up in the following pairings, which were repeated to me several times during my conversations with municipal leaders:

First the infrastructure, then the buildings.
First the environment, then the project.
First take care of relocation, then demolish.
First industry, then the city.

Each of these pairings was meant to illustrate a principled cure for China's "urban sickness." One planner told me: "Beijing, Shanghai, cities like that, they're already built; you can't just add the eco-infrastructures to them later, you have to do it first. Here in Gui'an, we haven't built the city yet; we start with the infrastructure under the ground—the sponge city infrastructure—then the roads. Then we build the city on top of that. It will be an important demonstration of how to fix [China's] urban problems."

Gui'an was also meant to demonstrate a solution to China's demolition-led urbanization. Planners told me that they were acutely aware of China's reputation as a "demolition and relocation" nation. The New Area was thus distinguished by the fact that the first major housing to be built was not high-end commercial residential developments, but relocation housing for rural residents, whose villages were demolished only after everyone had been successfully relocated and provided with employment. China's entrepreneurial urbanization had been driven, I was told, by real estate speculation, leaving ghost towns of empty apartment towers

and no industry, economic activity, or jobs. Those were just "fake cities," a blight on China's urban landscape. Gui'an would be different, since a great deal of information technology, telecommunication, and big data industry had already been built there. Villagers were getting jobs in these industrial parks even before they needed to be relocated. As one leader told me: "We're limiting real estate speculation: you can only buy land use rights if it's for industry; you can't just develop real estate. The only housing developments you currently see are relocation housing for farmers. Most of these apartments are still empty. There's no karaoke yet, no foot massage."

The focus on relocation housing for farmers is a reminder that the vast majority of the land occupied by the New Area is still rural. Gui'an is thus meant to model improvements in urban-rural integration. Initially piloted in Sichuan and Chongqing, urban-rural integration was an explicit part of the New Type Urbanization Plan, and it encouraged the extension of urban planning principles into rural areas that fell under municipal administration—often resulting in large-scale relocations of rural communities into new town developments. Ironically, urban-rural integration was accompanied by an aesthetic mandate that sought to maintain a visually rural character in the countryside, even as it became used in urban planning agendas. A focus on appearance thus informed the Xi administration's signature rural development initiative: the "beautiful countryside" project. "The city should look like the city, and the countryside should look like the countryside" was a phrase that began peppering the policy and planning discourses that accompanied the development of New Areas like Gui'an. Even as Gui'an implemented a plan to reduce the area's 366 natural villages to 170 by 2030, and to reduce the rural population of 120,000 by roughly half, planners sought to maintain clear spaces where the countryside would still look like the countryside.

The primary mechanism for achieving this was "village beautification," which typically entails applying a uniform renovation standard to which all the village structures must adhere (figure 7.3). Village beautification extends the ideology of the creation city into the countryside, enacting an urban planner's idealistic vision of the rural (Bray 2013). This aesthetic emphasizes whitewashed walls, sloping tile roofs, and various kinds of ornamentation, along with cleaned-up lanes and public spaces. The effect is to make villages look very tidy and picturesque, particularly from a distance. Many beautified villages in the New Area feature public signboards displaying information about the beautification project and the overall village plan. These displays bring the sensibilities of urban planning to the countryside. The village is treated by planners as a city would be treated, with the same kind of visual displays (including architectural renderings) that can be seen in urban planning all over China. The display images of the beautified houses

Figure 7.3. A beautified village in Gui'an New Area. (Photograph by Tim Oakes.)

manage to make them look like high-end suburban homes. The signboards also feature maps, charts, and diagrams: a whole performance of planning for the public to see.

Gui'an from the Street

How, then, do people inhabit the New Area? To what extent have their spatial practices conformed to the ideological renderings of Gui'an from above? And how do people use this infrastructure space? To what extent are they able to appropriate infrastructural urbanism in their pursuit of wealth? I address these questions by exploring a more street-level scale of experience and examining how the gridded landscape of infrastructural urbanism in Gui'an is being used in practice as the New Area develops.

Gui'an's grid of broad and straight new avenues slicing through otherwise hilly and undulating terrain has sprouted numerous roadside attractions, as local communities, investors, and governmental entities seek to capitalize on the roads' promised flows of people. These attractions pop up unexpectedly and often appear

abandoned and decaying, quickly going to ruin even before the roads are completed. The roads themselves remain largely empty, though they are immaculately cared for by teams of villagers working alongside the roads and in the medians, pruning shrubs, raking leaves, weeding, and otherwise keeping the landscaping tidy. They wear straw cone-shaped hats and bright orange vests. Their work often results in a stark aesthetic contrast between the well-kept roads and the empty shopping streets, amusement parks, restaurants, and other structures that locals have built in the hope of capturing some infrastructure-driven wealth. The road's landscaping also contrasts with the weed-filled fields visible beyond the guardrails, left fallow in anticipation of the urban development to come, as well as the piles of rubble, demolished concrete, and twisted rebar that line the highways.

There is a wide range of attractions. One community built a virtual-reality theme park, while another built a very scruffy theme park dedicated to the Three Kingdoms story of the Rattan Armor Tribe. There is a park featuring miniature versions of world-famous structures (including the Sydney Opera House, the Colosseum, and the Arc de Triomphe)—all built from rice husks. And just down the road, there is an empty Swiss Town, based somewhat loosely on the Austrian village of Hallstatt (and not to be confused with a more famous, or infamous, replica of Hallstatt in Guangdong). Swiss Town features empty, padlocked shops with windows (many of them broken) covered with large photos offering the impression that the shops are full of luxurious (and very European) things to buy. Tourists stroll through the town, kicking at the weeds growing in the cracks between the flagstones in the public square. The only life in Swiss Town is out along the road that passes it, where villagers set up food carts and fruit and vegetable stalls for the tourists. The roadside thus teems with activity and commerce, and villagers do a brisk business, with the ghost town as an odd scenic backdrop.

As a result of village beautification projects, whole villages have been turned into roadside attractions as well. Some of these villages have had to make themselves accessible by constructing "hacker" roads that informally connect to the new boulevards. Some of these beautified villages have been transformed into leisure resorts, with the majority of households opening restaurants or inns. In the villages I have visited, roughly half of these businesses were owned by outsiders, many of them from Sichuan. Meanwhile, many native villagers have purchased apartments in Guiyang or the University Town and have opened more city-based businesses.

The New Area's sponge city grid of drainage systems and monitoring stations remains largely undeveloped, even though pervious concrete has been laid throughout. It has become the chief symbol of Gui'an's eco-city aspirations. Villages have laid many kilometers of pervious concrete bike paths across their lands,

and similar paths have also been built alongside many of the new roads. But these have typically not been maintained. Many of the bike paths have been claimed by vines, bushes, and weeds. Some village fields have been converted into wetlands as part of the sponge city plan. But villagers have complained about polluted water flowing into these wetlands from some of the industrial parks nearby. Meanwhile, real estate developments pay only token adherence to the sponge city plan. New buildings are being surrounded by normal, impervious concrete, suggesting that developers do not think the sponge city infrastructure is viable, so they are building the way they always do.

The surveillance grid is experienced mostly in the form of facial recognition technology used for residents to gain entry to their apartment buildings. Most of the people I have spoken with say the technology makes them feel safe, since they rarely know their neighbors in these buildings. This is particularly the case in the University Town, where university staff enjoy apartments at subsidized rates—which they then rent out at higher market rates, pocketing the difference. The result is a building that houses not university staff, as intended, but people from anywhere, few of whom know each other. Since many of the rental arrangements are informal and unregistered, many of the residents are not in the security system's database, and thus cannot gain entry through the facial recognition process. For this reason, the cameras, doors, or both are often disabled, making it possible for anyone to come and go as they please.

Facial recognition is also used to record work shifts for many of the low-level staff at the big data companies throughout the New Area. Cleaners, cooks, and other unskilled workers must get their faces scanned to check in and out for their shifts. For the most part, these people are villagers who have been displaced by the construction of the New Area. Now they are on the front lines of state surveillance. They have shifted, practically overnight, from living in the relatively invisible space of the village collective, generally beyond the state's gaze, to living within the grid of the surveillance state—becoming unwitting participants in the experimental project of algorithmic governance being piloted by Gui'an.

This rapid transformation of villagers from agricultural laborers to surveilled service workers speaks to the way in which the previously rural communities of the New Area become part of Gui'an's infrastructure space. Infrastructural urbanism renders the agricultural landscape upon which it is built as an operational landscape, functioning to service the leisure, production, research, and educational activities of the new city. This happens in a number of ways.

Farmers who lose their land are typically promised service-industry jobs in the New Area. Many of them try the jobs for a few months but bristle at the set schedules, supervision, low pay, and tedium, and they quit. Many of the landscapers and

gardeners of the University Town are working on their ancestral land. I was told that about a third of the villagers on whose land the University Town was built remain as service workers. Another third are unemployed, and the rest have scattered in search of work in other cities. Those farmers who still have land flock to the University Town with food carts and wagons, selling barbeque and noodles to the students at the main university gates. They are an arresting sight, with their beat-up old carts and three-wheelers belching cooking smoke next to the slick architectural spectacles of the new university campuses around them.

The government has worked to keep members of the rural population of Gui'an from scattering when their land is appropriated for construction. When the New Area was established, incentives were provided for people to move back to the area and start businesses. This was part of the Xi administration's broader set of policies, under the slogan "send capital to the countryside." The policies were particularly effective in providing start-up capital for turning houses into restaurants and leisure guesthouses in villages that had been beautified. One villager told me that the incentive package was CNY 5,000 (about USD 775) plus an air conditioner. This program was discontinued after a couple of years, but it had a significant impact. Many village proprietors told me they had returned from working in coastal cities to their home villages because of the incentive program. This has also been good for children. In the rural schools in the New Area, there are now very few "left behind children." Throughout Guizhou, roughly half of the students in rural schools are such children, left behind with relatives while their parents seek employment in distant urban centers. In Gui'an the number is about 5 percent.

The ideology driving Gui'an's vision of itself as a new model of urban-rural integration has led planners to advocate for a more pastoral and culturally authentic countryside amid the industrial zones and commercial housing estates of the New Area. The ideology of keeping the urban and the rural aesthetically separate means that beautified villages are supposed to remain quiet and peaceful—not like the commercial theme parks or crowded "villages-in-the-city" that some rural communities have become after being engulfed by urbanization. One village head told me that "the government has a plan for tourism development here, and so we have to protect our land, and keep things peaceful and quiet here—not like the city. Our village will not be like Xijiang, which is overcommercialized. We will be more bucolic and pastoral, more authentic." In referring to the highly developed Miao tourist site of Xijiang in southeast Guizhou, the village head was suggesting that commercially intensive theme-park-style village development was no longer the model that it had been just a few years earlier. Discourses of cultural authenticity encapsulated by the term "*yuanshengtai*"—which indexes a more natural and

primal version of cultural development—have emerged to reshape popular notions of the rural and "rural nostalgia" (Kendall 2019; Luo 2018).

While a few beautified villages have been turned into bucolic repositories of rural nostalgia for urban residents, the remaining rural communities throughout the New Area are rapidly being demolished, with their residents relocated (theoretically, at least) into large resettlement compounds that can also be found alongside the roads in the new grid. Many villagers I interviewed said that they were happy to become workers in the New Area, and that this was preferable to working in some distant city. And they *want* the government to buy their land—the sooner the better. Many told me they were able to work in or near the New Area and still take care of their aging parents. Most told me that nobody farms anymore; much of the land lies fallow. Nobody is interested in farming, and nobody is interested in renting the land. Everyone is just waiting for a compensation package to come their way.

These compensation packages have been relatively generous, in comparison to what one finds throughout the rest of Guizhou, and in rural China more generally. Residents of demolished villages have the option of taking a cash payment or getting relocation housing. While no one could provide me with actual numbers, officials in Gui'an believe that most of the villagers take the cash payment, leaving much of the relocation housing empty. "Many of them gamble away the cash," one told me. "Or buy a car, just so that it looks like they're rich and successful, even if they don't know how to drive." At the same time, many rural residents are defrauded by schemers who have swarmed into the area, knowing that it is newly awash in cash. Some farmers, I was told, have lost all their compensation money this way.

The relocation compounds are built on a large scale, with the idea that they will eventually become thriving commercial and residential communities with parks, shops, and restaurants. But for the most part, the shops remain empty. Weeds push up between the paving stones in the courtyards between apartment towers and in the empty parking lots, playgrounds, and pathways (figure 7.4). Playground structures and exercise equipment—the tools of the civilized urban life that Gui'an seeks to demonstrate—seem abandoned and broken, covered in dust and weeds. At one of the compounds I visited, only about 10 percent of the apartments were occupied. Across the broad fourteen-lane boulevard that it stood next to (yes, fourteen lanes!) stood forlorn villages, also empty, awaiting demolition. Some of the workers in the New Area told me they are afraid to venture into the relocation housing. They fear it is too chaotic, too full of hooligans, drugs, and gambling. They assume that the compounds are full of thieves and drugs because the residents have money but no jobs.

Figure 7.4. Decaying relocation housing in Gui'an New Area. (Photograph by Tim Oakes.)

There is a broader discourse among officials and many residents that the loss of farmland and village communities, combined with generous compensation, creates a situation ripe for moral decay. One day, I was talking to some women who were playing cards in a village lane. I said, "Oh, you get to relax and play cards on a Sunday—that's nice." A woman replied, laughing, "Sunday or not, we play cards all the time!" My driver took the opportunity to tell me that everyone in Guiyang is joking these days about how they want to marry a Gui'an villager because they have gotten so rich. The woman went on to say that she now loves to travel: "I've been to Shanghai, Beijing, Nanjing, Hong Kong—all just for fun!" Another woman commented: "The new road here makes everything so convenient for us now. We can come and go easily. Nobody needs to do any farming anymore. Most of the younger people in the village work at Foxconn. They don't have to go to the distant cities of the coast to work anymore; they can work right in our own backyard. The Foxconn salary is OK—not as high as if you own a restaurant here in the village, but it's pretty good." I was told that Foxconn employs about twenty thousand people in the New Area, many of them villagers. In several of the villages I visited, the majority of village youth were working there.

Later in the same village, I talked with a restaurant owner about the rise in drug use and gambling. There was a sense in our conversation that the place had become somewhat unmoored and that some people had lost their way. "They don't need to work, they don't want to farm. They can just gamble and get high," the man said. He told me the price of tobacco had been going up because "old guys just sit around and smoke; they don't care about the price. If they want to go to the University Town, they just hire a taxi. In the past they used to walk!" Local officials have made it a point to try to introduce villagers to a healthier lifestyle, one that involves exercise and other recreational activities like travel. In response to my question about whether anyone farmed anymore, for example, a village schoolteacher said, "Now the villagers understand that they still need to do some farming. It's good for their health, a kind of exercise, and it gives them a little bit of something to sell to tourists."

Infrastructure and Ideology

When farming is promoted as a form of exercise for a healthier lifestyle—as opposed to a means of survival and sustenance—a significant transformation in spatial practice has occurred. This transformation has been generated through a form of infrastructural urbanism that has produced an infrastructure space of grids. This space in turn reshapes the land into a service platform with interchangeable uses. Such interchangeability can be seen in the way that the grid of new roads creates separate and equivalent sections of countryside; in the way that the beautification of villages in these sections achieves a generic "rural bucolic" appearance that is the same across the entire landscape; and in the way that agricultural labor, unmoored from these sections, becomes unskilled service-industry work throughout the New Area. As an infrastructure space, Gui'an is not only an interchangeable landscape, but also an open resource for wealth generation. Residents have responded with ephemeral roadside attractions, and by turning their villages into sometimes vibrant commercial centers for leisure and recreation. The government has encouraged this with generous compensation packages and incentives for entrepreneurial residents to open businesses.

Yet Gui'an is also an ideological space, and as such it presents often conflicting messages. Beautified villages are supposed to be peaceful and bucolic, not commercial and theme-park oriented. And villagers themselves should have healthy and civilized lifestyles, rather than gambling and using drugs. Model designs for resettlement housing have gone unrealized as many villagers take their compensation packages and buy apartments in the city. Meanwhile, the government seeks to brand Gui'an with a degree of "local Guizhou color" in terms of design themes

and motifs, even while beautified villages appear generic and similar to rural reconstruction projects throughout China. In short, the ideological and infrastructural spaces of Gui'an fail to complement each other, resulting in contradictions embedded within the policies and practices that shape the outcomes in the New Area. These contradictions are most apparent when we consider the way Gui'an as an infrastructure space has transformed the Guizhou countryside into an operational landscape of service provision for the creation city ambitions of the New Area. As Tadiar (2016) has argued, such landscapes depend on grids of roads and highways (the infrastructure of circulation) to bring the "vital infrastructure" of a newly displaced service class to the sites where their labor adds to the value of the "trans-territorial city." The tensions between these ideological and technopolitical projects of creation city and infrastructure space are producing unexpected and uncertain landscapes that are neither conventionally urban nor rural. Viewing Gui'an as an infrastructure space, rather than as a city in the making, thus helps make clear the constellation of forces that are shaping the spaces of development in China today.

Note

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CHAPTER EIGHT

Road's End

Lines and Spaces across a Divided High Asia

TILL MOSTOWLANSKY AND TOBIAS MARSCHALL

On a cold afternoon in April 2019, a dozen men blast and dig a road into the rock alongside the shepherd tracks in the Wakhan Corridor, a narrow strip of territory in eastern Afghanistan.[1] These men, contracted by a major road construction company in Kabul, have been there for many months and expect to work for several years more on the road, which is planned to eventually connect Afghanistan and China. Conducting research on emerging infrastructure projects in the Wakhan, we arrive at the construction camp on foot coming from Sarhad-e Broghil, a trip that took us a few hours up the roughly ten kilometers of gravel road. By spring 2021, contacts in the Wakhan tell us that the road has progressed another sixty kilometers. It now reaches halfway to the border with China, to a place called Baza'i Gonbad. This is a milestone location on the road to China, but it is also a settlement of Kyrgyz and Wakhi herders, and thus a gateway to a world of pathways and high-altitude pastures.

As we learn during our research, there are many ways to perceive and make use of this new road. Seen from Kabul, the road to China is part of a grander vision of connectivity with Afghanistan's economically and geopolitically dominant neighbor to the east. The road to China fits into the trope of the Silk Road, which Afghan and Chinese politicians have frequently used to frame transport infrastructure. However, this vision is a fragile and heavily future-oriented one. In the Wakhan, the road—which barely fits two cars at once—also promises to create tangible new links between the region's marketplaces, pastures, and mountain settlements on a local scale.

The emphasis on new is important, as the Wakhan has long been covered by a web of routes that have, to varying degrees, accommodated motorized transportation, pack animals, and people walking, including across nation-state boundaries. The connectivity that these routes offer defies the idea that large-scale development brought by a link to China is a precondition for people's mobility, economic activity, and security, as state discourse often implies. In fact, much of what is today seen as future connectivity already exists, under various auspices and with unexpected effects. For instance, while conducting research in the high-altitude parts of

the eastern Wakhan in 2016, a vast area usually thought of as accessible only on foot, Marschall encountered motorcycles, cars, and tanks. Motorcycles, used to collect fodder, were brought by yak from Sarhad-e Broghil across the steepest parts of the route. A man bought a Toyota Hilux from the northern Afghan city of Faizabad that was delivered via Tajikistan on paved roads across a largely flat plateau. In that same year, Chinese tanks and soldiers used the connection across the plateau to patrol, with the permission of the Afghan government, deep in Afghan territory.

Historically, roads have been crucial sites for the expression of political ideology (Guldi 2012). This importance persists in the present era, in which connectivity with China offers new patterns of legitimacy. We thus begin this chapter with a reference to contemporary development in the Afghan Wakhan, as it points to deeper historical processes relating to infrastructure, scale, and spatial transformation in the borderland of Afghanistan, China, Pakistan, and Tajikistan. Taking infrastructure and scale as guiding themes allows us to situate the story of road construction in the Wakhan today as part of a broader spatial transformation that has shaped this borderland over the past century. This has implications for our view of infrastructure projects on both empirical and theoretical planes.

Much of the literature on this part of High Asia emphasizes fracture and division over interaction and connection.[2] However, based on historiography, we argue that ideologically driven transformations of space have in fact resulted in the coexistence of overlapping networks in the borderland of Afghanistan, China, Pakistan, and Tajikistan. As we show in this chapter, colonial boundary making, Cold War separation, and an emphasis on the nation-state have clearly shaped the construction of infrastructure and people's mobility. Yet this has not happened in strictly compartmentalized forms; while political boundaries have been an important factor in this area, their significance is sometimes overstated. We propose that thinking through infrastructure and scale opens up a perspective beyond preconceived territorial containers. It is a perspective onto a world of different routes—connected and disconnected, unpaved and paved—that we view as "crucial sites for an unfinished modernity" (Clifford 1997, 2).

In discussing these processes, we build on the decades-long debate about the relation of space and place[3] that has perhaps most poignantly culminated in the intellectual encounter between Doreen Massey and Tim Ingold. In their work on space and lines, respectively, Massey (2005) and Ingold (2011) take differing stances. While Massey emphasizes the virtue of space as bridging the abstract and the tangible, representation and practice, Ingold rejects this approach as prolonging an unnecessary and oppressive binary. He favors using movement between places to capture how humans inhabit their environment. However, we read Massey's

and Ingold's work as compatible in seeking to understand contemporary spatial practices as embedded in abstract historical processes and daily life. We thus argue that Massey's (2005, 9) insistence on space as a "product of relations" and the "simultaneity of stories-so-far" lends historical and scalar depth to Ingold's (2011, 34) view of habitation as "lineal."

Against this backdrop, in our analysis of the contemporary Wakhan we spatialize the local history of modernity as well as follow the lines of connectivity across the borderland's multiple boundaries. Various projects of modernity, having mushroomed across the region, are fundamentally interconnected and part of a web of routes in which people and institutions interact. While state actors tend to perceive large road construction projects in this web as central, they are not economically or politically dominant over footpaths in everyday life. Thus, in this transregional web of routes, scales are not hierarchically preordered levels or layers, but should rather be imagined as "capillary" (Latour 1996, 370) and as gaining broader visibility and importance in specific sociopolitical contexts and historical moments.

The chapter is grounded in Mostowlansky's decade-long ethnographic and archival research in Afghanistan, Pakistan, and Tajikistan, and in Marschall's ethnographic fieldwork with the Kyrgyz of the Wakhan.[4] First, we continue the discussion of contemporary road construction and the fluid interface between roads and pathways in the Afghan Wakhan. Next, we expand on the historical legacy of Soviet infrastructure that has marked the Wakhan since the 1980s. We then deepen the engagement with this historical legacy by exploring road construction and the transformation of space in Soviet Tajikistan, which has led to a vital connection to China via the Pamir Highway (*Pamirskii trakt* or *Pamirskii shosse*). Continuing with the subject of connectivity with China, in the final section of the chapter we analyze the construction of the iconic Karakoram Highway since the 1960s as a central catalyst for the transformation of routes in northern Pakistan. In the conclusion, we return to the Afghan Wakhan to reassess the emerging web of routes in light of the history of construction and mobility in neighboring places.

The End of the Road on the Roof of the World

Afghanistan's Wakhan Corridor, a narrow strip of land bordered by China, Pakistan, and Tajikistan (figure 8.1), is a legacy of nineteenth-century territorial agreements between the British and Russian Empires.[5] Based on its history as an imperial and Cold War buffer zone, the Wakhan and its ethnically and linguistically diverse people have long been portrayed in popular, political, and (perhaps more surprisingly) academic discourse as remote, disconnected, and somewhat

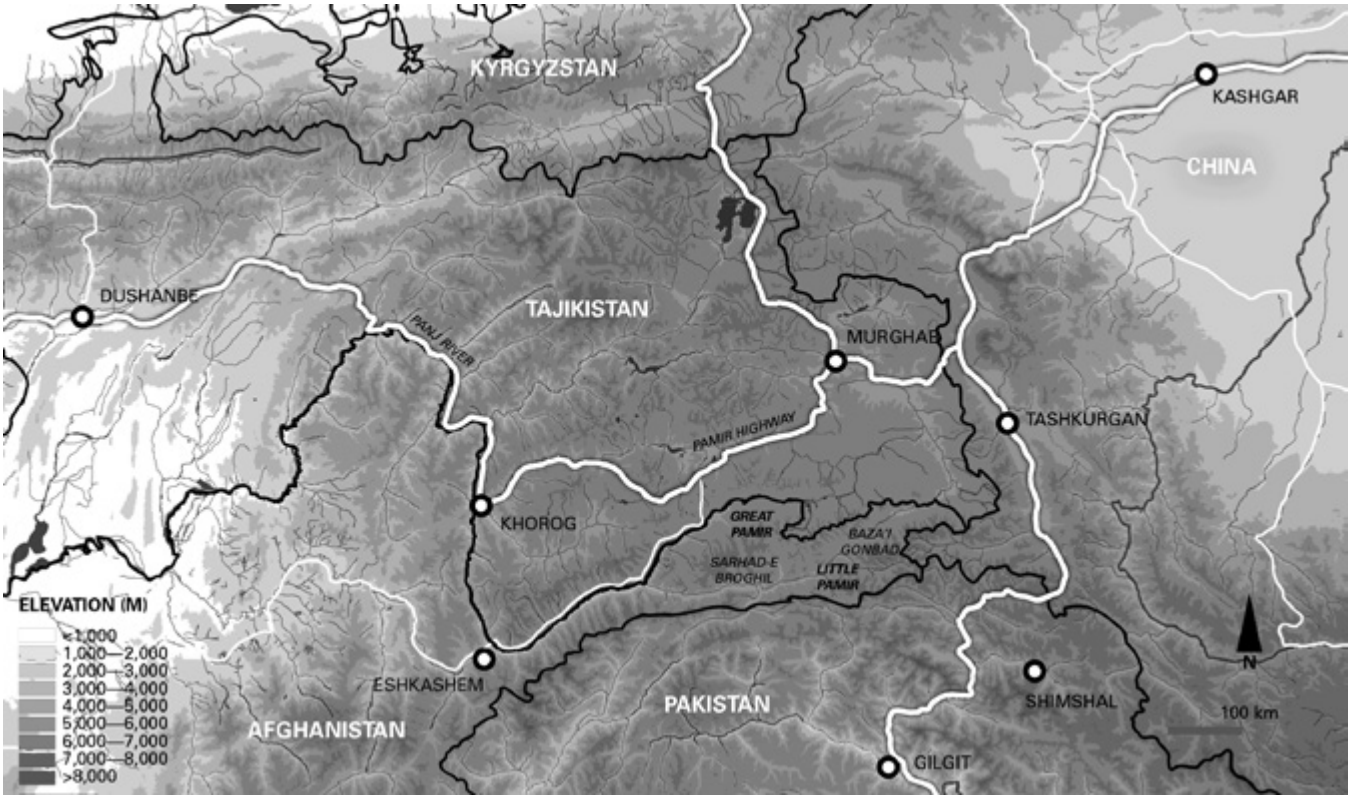

Figure 8.1. Geography of High Asia. (Map by Dorothy Tang. Made with Natural Earth and GMTED2010 data. See GMTED2010 2011.)

stuck.[6] There are a number of reasons for this stance, of which the Wakhan's status as a cul-de-sac at a securitized frontier is an important one.

However, fieldwork in the Wakhan reveals that, against these odds, people there are often highly mobile, and have been so for decades (Mostowlansky 2021). In our joint and individual research periods in the Wakhan we met many interlocutors who, for instance, had gone to college in Kabul; served in the army in other parts of Afghanistan; lived in China, Kyrgyzstan, or Pakistan; ran cross-border trades and had been overseas. Thus, in contrast to many exoticizing depictions of the Wakhan as an extremely localized place that—for better or worse—provides a haven from the world, in our fieldwork we found that, as Massey (2005, 195) reminds us, the world was right there.

For discussions of infrastructure and roads in the Wakhan, this recognition is central. It offers an opportunity to perceive the road to China not as modernity coming into a backward land, but as a connection to and reshaping of already present structures. In this context, the contemporary Wakhan is linked to a number of transregional processes, including the material legacy of Soviet assistance, Cold War and post–Cold War development, and simultaneous forms of economic and social organization in neighboring areas. We therefore explore the emerging road to China as an example of third-wave state-driven construction with twentieth-century predecessors.

In April 2019, we stayed at the camp of the workers who are building the road that is supposed to eventually connect the end of the Afghan road system in Sarhad-e Broghil with the Chinese road system. The construction workers and engineers, employed by a government contractor from Kabul, began by building a sixty-eight-kilometer stretch from Sarhad-e Broghil to Baza'i Gonbad. Only in the coming years can a plan be made for links across the borders with China and Pakistan. The road is an arduous and slow ten-year project, and it largely follows older shepherd tracks carved into the steep slopes above the Wakhan River. While workers approaching from Sarhad-e Broghil blast and dig the new road into the rock, construction teams on the plateau around Baza'i Gonbad employ heavy machinery to grade less hazardous stretches. Large excavators and dump trucks have been brought in via both Tajikistan's nearby road system and yak and camel tracks in the Wakhan, and their presence demonstrates the fluid interface of routes and nation-state boundaries in the area.

Both the Afghan state and nongovernmental organizations (NGOs) in the Wakhan differentiate, on maps and in reports, between two distinct systems of mobility: a motorized one that operates on the road from Eshkashem to Sarhad-e Broghil, and one based on walking and animal transport on the high-altitude pastures of the Great and Little Pamirs at the border with China. However, this static

distinction is rarely valid in daily life, as many people walk or ride horses on the road due to a lack of vehicles, and motorcycles, tanks, and construction machinery routinely appear on the pathways. Routes in the Wakhan are all called *jol* in Kyrgyz, no matter whether they are designed for motorized transport or walking. This acknowledges that rugged and unstable terrain can change quickly depending on location and weather.

As road construction progresses, the question of who gets to use and profit from a potentially more stable motorized route has gained importance. Echoing a number of recent anthropological studies on road construction,[7] Marschall's research among the Kyrgyz of the Wakhan shows that the new road is not met solely with appreciation in places where the main mode of transportation is on foot or by horse. He encountered frequent worries that the road would infringe on the Kyrgyz's systems of pathways and creep into their modes of life, and thus into an existential form of wayfaring (Ingold 2011, 148). For instance, in Andamin (at the Afghanistan-Tajikistan border) in April 2019, Marschall met Raimberdi, a Kyrgyz cattle breeder in his twenties, who saw the emergence of the road as a dark event that had to be opposed by "the people" (*el*) as it would bring "destruction" (*nukus*) of sociality and hospitality, the rise of "self-focus" (*özü köröt*), and the eventual decay of both "spiritual merit" and "divine blessings" (*sawab* and *barakat*). As they rode and walked along the steep path down to the valley, Raimberdi told Marschall that he feared the motorized road would serve only the wealthiest, and that "the people" would continue to move by horse or on foot.

Perceptions of state-driven modernization projects as transformative and violent incursions that come with unequal opportunities have existed in the Wakhan for several decades. The emergence of roads and bridges in the area began with the Soviet invasion of Afghanistan in 1979. In order for tanks and other military supplies to reach strategic locations at the border with Pakistan at the Broghil Pass, dirt roads and steel bridges had to be built. While the Soviet army's forts and checkpoints in the Wakhan have largely decayed, stretches of roads and, particularly, bridges remain as significant traces. These stand for a state of occupation, but they also evoke nostalgic memories of employment and protection that many of our middle-aged and elderly interlocutors framed in the oft-repeated words "the [Soviet] Union was good" (*shuravi khub bud*).

Since the early 2000s, international development projects have mushroomed throughout the Wakhan. These projects build on and aim to transform Soviet paternalistic visions of modernity and state-citizen relations through a decentralized blend of NGO initiatives and internationally sponsored government projects that are often only loosely coordinated. However, with respect to the motorized road leading through the Wakhan, there has been a clear distribution of labor. On the

one hand, there is the Aga Khan Development Network, a group of Ismaili Muslim institutions strongly anchored among the Wakhi population in the lower parts of the Wakhan. The network's engineers have focused exclusively on the construction of bridges. On the other hand, road construction has been left to the Afghan government, whose contractors improve and extend roads at a comparatively slow pace. As a result, throughout the Wakhan bridges can be found in places where paved roads are still missing.

Meanwhile, on the plateau of the Afghan Pamirs, more than 4,200 meters above sea level, people have been affected rather differently by these developments. In the absence of large international NGOs, which often follow paved roads, a need for military infrastructure has driven the extension of footpaths and the construction of camps. Former Soviet army bases have been transformed into outposts for the Afghan army, and (like Soviet forces decades earlier) Chinese tanks have rolled across the flat parts of the Pamirs in the pursuit of border security cooperation.

In July 2016, Marschall observed the simultaneous presence of decrepit Soviet army bases, Afghan soldiers, and Chinese tank tracks in the area of Baza'i Gonbad. The long-standing incursion of motorized military personnel into the area indicates alternative ways of reaching the plateau. Soldiers crisscross international borders in the triangle of Afghanistan, China, and Tajikistan, and they arrive in the Pamirs without having to actually walk on pathways. Instead, they make use of the interconnected Tajik and Chinese road systems to enter Afghanistan, moving across passable mountain pastures and well out of the way of official border crossings.

The daily life of Kyrgyz and Wakhi shepherds in the Afghan Pamirs is entangled with this fluctuating presence of outsiders, but in the process of herding livestock between summer and winter pastures, it also runs a separate course. In the Great Pamir in May 2019, Marschall observed, as part of the World Food Program's Food for Work Program, the broadening of footpaths to allow caravans of Bactrian camels to move more freely and efficiently across the region. Using simple tools and shovels, Kyrgyz and Wakhi laborers worked on these pathways in exchange for tea, dairy products, flour, and rice. Likewise, *sawabkhanas* (houses of spiritual merit), which have been constructed across the borderland to provide communally funded accommodation for travelers, remain outside the reach of foreign investment. They are sites of local giving and reciprocity, and allow for the display of wealth as well as the reward of spiritual merit. Unlike those in northern Pakistan, *sawabkhanas* in the Wakhan are exclusively constructed and maintained by people who actually traverse the area.

In the following section of the chapter, we explore more deeply an essential part of what Massey (2005, 9) calls the "simultaneity of stories-so-far"—one that

is central to an understanding of routes not only in the Wakhan but in the High Asian borderland more broadly. Examining the lasting impact of Soviet modernity (and hence road construction), as well as its afterlife in the practices of contemporary state institutions and NGOs, is relevant with respect to the Tajik road system just across the high-altitude border between Afghanistan and Tajikistan. The Soviet legacy's continuous influence in the Wakhan makes this a historical as much as a contemporary issue.

Overcoming Roadlessness

When people in the Afghan Wakhan glimpsed Soviet modernity during a decade of occupation in the 1980s, inhabitants of the Soviet Union's territory just across the river had already lived through decades of state-driven modernization. Roads played a central role in the imaginary of an integrated, coherent, and self-sufficient socialist space (Siegelbaum 2008a, 125–172). By the end of the first decade of Soviet rule, "roadlessness" (*bezdorozh'e*) had been identified as a major issue on the path to communism. Hence, the 1930s brought widespread construction across the Soviet Union. As Lewis Siegelbaum (2008b, 277) describes, quoting a Soviet official speaking about rural Russia in 1929, the lack of a sophisticated road system was increasingly seen as a sign of "the survival of barbarism" and of "Asiaticness, indolence, and idleness."

Accordingly, the Soviets launched road projects across their country, which bore some similarity to Nazi autobahn construction programs. They improved connectivity between major cities that had already been linked by highways (*shosse*) in the Russian Empire, but they particularly sought to end roadlessness in much more remote parts of the Soviet Union. To this end, the mountainous region of today's eastern Tajikistan, bordering the Afghan Wakhan and China, became the site of a large road construction project that lasted in different forms throughout the Soviet period, and continues to captivate the imagination of planners and politicians.

Rather than linking major urban centers, the Pamir Highway was built to connect the Pamirs with the closest town, Osh, in southern Kyrgyzstan. The highway leads across a number of mountain passes and through the plateau of Murghab to the settlement of Khorog, at the former Soviet-Afghan border. Clearly, there was a military rationale behind the highway's construction, but Soviet aspirations were multidimensional and extended into taming and transforming space (that is, territorialization) through the creation of modern roadside communities (Mostowlansky 2017). Thus, while the highway eventually facilitated Soviet tanks' rolling into the Afghan Wakhan in 1979, more than four decades of "the fight for the

road" (*bor'ba za dorogu*) had also aimed to bring socialism into a hitherto "inaccessible periphery" (Slavinskii 1935, 3). The transformation of a previously roadless mountain region at the edge of socialism came to symbolize Soviet progress and connectivity.[8]

In his book *Naqliyoti Tojikiston* (Transport in Tajikistan), Ahmadjon Ismoilov (1962, 42) demonstrates that the transformation of remote areas of Central Asia depended on the increasing penetration of the Soviet state via road and railway networks. Ismailov's account begins with pre-Soviet pathways that characterized poor districts, and it ends with large construction projects that had, step by step, brought connection to the imagined periphery (Ismoilov 1962, 58). Similarly, Sadullo Nazrulloev (1979, 91) points to the essential role of the road in establishing political and economic legitimacy. Prior to construction of the Pamir Highway, Tajikistan's eastern border region with Afghanistan and China was inaccessible to motorized transport. The highway provided connectivity to Dushanbe (the Tajik Soviet Socialist Republic's capital) to the west, and to the closest railway station (in Osh) to the north.

In official Soviet representations, unpaved roads and footpaths were viewed as undesirable remnants of the past that were expected to disappear with the rise of an increasingly dense network of paved roads. Research from across the former Soviet Union shows that this was typical of the idealization of a progressing socialist space whose available resources were often grossly overstated.[9] In the case of the high-altitude environment of the Pamirs, two additional factors significantly complicated the relationship between different routes traversing the region.

First, the paved road between Osh and Khorog, roughly 730 kilometers long, leads through hazardous mountain terrain that is susceptible to avalanches and mudslides, and where a freshly tarred road surface can erode within weeks. While continuous maintenance is part of every road construction project, roads like the Pamir Highway that are subject to extreme environmental conditions require particularly intensive economic and political investment. Thus the "fight for the road" in the Pamirs, or the lack of it, has always been characterized by where political and economic actors see necessity, potential, and gain.

Second, what began as an underfunded Soviet project to connect the periphery in the 1930s has morphed over the past twenty years into a rerouted corridor to China. Throughout this process, neglect has led to such a degree of decay on certain stretches that travelers occasionally have to walk. In his research with road construction workers and drivers along the Pamir Highway, Mostowlansky found that such stretches are considered inferior even to unpaved gravel roads or pathways across mountain pastures, since they are unpredictable, damaging to vehicles, and symbolic of the general retreat of Soviet modernity in the region.

Although the use of the highway has been contested by state institutions, NGOs, foreign governments, and local residents, it has also fostered a web of interlinked routes. From the 1940s onward, the development of the highway in combination with Soviet policies of border closure and forced isolation led to the decline of trade links and cross-border pastoral herding (Kraudzun 2011, 173). The most frequently used trade route between the Pamirs and Kashgar (a city in nearby Xinjiang) was severed, and people's mobility began to depend on the railway hub in Osh. Cutting local residents off from their customary economic and kin connections with China and Afghanistan was an essential component of the Soviets' creating a loyal borderland population (Kassymbekova 2011, 362). The highway became a center around which checkpoints, research stations, and jeep tracks and pathways to mountain pastures were organized within the confined space of a Soviet Cold War frontier. The Soviet invasion of Afghanistan and the end of the Cold War loosened this arrangement and provided room to extend the existing web of mobility across the border. This happened in a manner that remains state-controlled and securitized. To this day, contact between Tajikistan and Afghanistan citizens is largely restricted to humanitarian missions, medical treatment, border markets, and a few NGO initiatives.

Connectivity between Afghanistan and China is similarly controlled, although since 2004 a road link between the Pamir Highway and the Chinese road system has greatly increased trade activity between the two countries (Mostowlansky 2017, 135). Moreover, since 2016, the Quadrilateral Cooperation and Coordination Mechanism has resulted in military cooperation among Afghanistan, China, Pakistan, and Tajikistan, and has enabled new forms of mobility on the region's routes.[10] Having put a military base in place in Shaymak, at the Tajikistan-China-Afghanistan border, Chinese forces now navigate freely between the three countries (Shih 2019). Its military vehicles and personnel travel via Tajik roads and across pastures into the Afghan Wakhan, where they participate in joint exercises, surveillance, and border patrols.

By contrast, in northern Pakistan, road construction to and with China has a much longer history and has informed connectivity across the border since the 1960s. The ways in which this has transformed the relationship between existing pathways and new tarmac are illustrative of the ongoing process of building the road to China in the Wakhan.

New Routes Abound

The Karakoram Highway, connecting Pakistan's capital, Islamabad, with Kashgar in China, is perhaps High Asia's most iconic and widely advertised road construction

project. The 1,300 kilometers of tarmac are the result of a close political and military alliance between Pakistan and China since the 1960s. The highway is intricately intertwined with the ongoing conflict in Kashmir between Pakistan and India, but it also facilitates international and domestic tourism and has fostered rapid social transformation.[11]

The highway's origins date back to Cold War considerations in which anti-imperialism and South-South cooperation played an important role (*Dawn* 1963). In this respect, the highway can be seen as a counter to the Soviet Pamir Highway across the border, which was built on the legacy of Russian colonialism. However, the Karakoram Highway, like the Pamir Highway, has been as much a military endeavor as an economic one. The former highway, which today is officially part of China's Belt and Road Initiative through the China-Pakistan Economic Corridor, was predominantly built by the Chinese and Pakistani armies, and it has facilitated the movement of troops in border areas (Joniak-Lüthi 2016). The building of roads in Xinjiang by the People's Liberation Army and, more generally, the territorialization of China's western provinces through infrastructure were preconditions for the construction of the Karakoram Highway in Pakistan. The involvement of Pakistan's Army Corps of Engineers in infrastructure projects since the 1960s eventually became formalized as the Frontier Works Organization, which remains a major public works provider tied to the country's military-economic complex (Khalid 2009).

In Pakistan's far north, at the border with Afghanistan and China, the construction of the Karakoram Highway has had a particularly transformative effect, literally turning footpaths and cattle trails into paved roads within the course of a decade. In this area, directly bordering the Afghan Wakhan, the opening of the road to China in 1982 has been less significant than the access that the highway has provided for NGOs and state development. Similar to current processes in the Afghan Wakhan and the Tajik Pamirs, the Aga Khan Development Network built upon existing and emerging infrastructure by introducing health care, education, and social and economic programs.[12]

Much research on northern Pakistan has dealt with the socioeconomic changes that the Karakoram Highway has brought to the region: how lifestyles and livelihoods have been transformed and how people's interactions with the environment have adapted to altered agricultural practices and increasing tourism.[13] The highway's existential importance, developed over the past four decades, has repeatedly become clear in the face of disaster (Rest and Rippa 2019, 380)—most recently in 2010, when the Attabad landslide led to the destruction of a stretch of highway and to the creation of a twenty-two-kilometer-long lake. Against this backdrop,

the Karakoram Highway's central and iconic status has overshadowed an intricate system of seemingly less significant routes that intersect with it.

The construction of the Karakoram Highway left many settlements far from the main artery still disconnected from motorized transport, and walking to the road remains an integral part of daily life for the people there. One of these settlements is Shimshal, an assemblage of three village communities where Mostowlansky conducted several weeks of fieldwork in 2016. Shimshalis sustain themselves through a mix of mountain farming, herding, and labor migration, the latter of which has grown in importance since the completion in 2003 of a forty-kilometer road linking the village to the highway.

Connectivity has steadily increased since the 1970s, when a journey to the nearest market town required a week of walking and additional days of riding on a pony track (Butz and Cook 2011, 356). However, Shimshalis continue to experience fluctuation between accessibility and road closure. Shimshalis began to construct the forty-kilometer road in 1985 themselves, and in the following eighteen years they worked with the occasional assistance of international NGOs and the local government (Ali and Butz 2005). While the road, as a communal achievement, is a source of pride, it is often seen as fragile, given that floods and landslides frequently damage the road and leave Shimshalis once again without access. At the same time, due to much broader changes in political ecology, the road is seen as a threat to a calmer, less mobile life in Shimshal (Hussain 2015). As David Butz and Nancy Cook (2016, 206) point out, Shimshal's subsistence-based mode of life has undergone massive changes since the 1980s, including the arrival of new work opportunities outside the valley, an increase in cash transactions, the appearance of NGOs, global conservation governance, access to health care, changes in diet and education, and the emergence of agricultural machinery and tourism.

These changes in Shimshal have been strongly linked to the construction first of the Karakoram Highway and later of the local link road. Yet it is easy to overlook the fact that, as these roads came into existence, Shimshal's nonmotorized routes began to play a new role—not only with regard to road closures, but also in realms that remain seemingly untouched by the speed of motorized transport. At the end of the link road, a system of footpaths and cattle trails extends to Shimshal's high pastures. The end of the road thus embodies the difference between transport and wayfaring (Ingold 2007, 81). Yet it is also there, on the narrow pathways carved into the rock high above the river, that the road's transformative force has penetrated a world of cattle, shepherds, and communal labor.

The routes from the village to the pastures around Shimshal Pass, leading from 3,100 meters up to 4,735 meters above sea level at the border with China, have been

important lifelines for Shimshali yak breeding. They constitute entry points into a world of natural beauty and idyllic disconnection, and are in need of constant maintenance.[14] The annual repairs are organized communally, and Shimshali men take turns working on sections of the paths damaged by heavy snowfall, rain, landslides, and avalanches.

Along these paths, travelers encounter simple stone huts that provide shelter for the night. As in the Afghan Wakhan, these huts are called *sawabkhanas*, and their funding and construction are acts that generate merit in relation to God. Yet while *sawabkhanas* in the Wakhan are part of a local moral economy that remains disconnected from outside actors, Shimshali *sawabkhanas* have developed into a transnational phenomenon that is directly related to the emergence of the Karakoram Highway. With the rise of tourism in northern Pakistan, and in Shimshal in particular, mountaineers from all over the world have visited the area, developed personal relationships with Shimshalis, and claimed stakes in local practices. As a result, and as observed in the course of Mostowlansky's fieldwork, many *sawabkhanas* are now financially supported by foreign donors and have been named in their honor (such as Shimshal's Leutkircher Hütte, whose name refers to its German sponsors). While the centrality of herding for economic purposes has decreased on Shimshali mountain pastures, the maintenance of pathways is now financed by international visitors. Local communal endeavors have thus become linked to a much wider web of connections spanning footpaths, roads, and circuits of global mobility.

Conclusion

Much of the research on the Afghan Wakhan, and indeed on other parts of High Asia, invokes a sense of timelessness and inertia. This is not surprising, given the area's long-standing status as an imperial buffer zone, surrounded by international boundaries of geopolitical concern. It is convenient to think of roads to China as providing visions of future connectivity and new beginnings (Rippa, Murton, and Rest 2020). In contrast, we argue that ongoing road construction in the Wakhan is a spatial encounter with what Massey (2005, 195) calls "the radical contemporaneity of an ongoing multiplicity of others, human and non-human." In other words, the afterlives of the modernization projects that have been present in the Wakhan for many decades influence how emerging projects of modernity become both locally specific and connected to a wider world.

For people in the Wakhan, the road to China stands for an array of possibilities, among which actual connectivity to the Chinese paved road system is only one. The current construction project also promises the people of the lower

Wakhan much easier access to the world of cattle trails and mountain pastures where they can seek short-term employment as shepherds, and it formalizes the Chinese military presence in the borderland that has existed for years. Afghanistan's road to China is being inserted into a web of routes throughout the borderland that remain largely hidden behind large infrastructure projects. The transregional dimension of this process is related to spatial encounters on the thoroughfare between east and west, often embedded in tropes of the Silk Road. But it is also linked to frequently neglected north-south connections (Marsden and Mostowlansky 2019). As the road to China progresses, the plateau between Tajikistan and Afghanistan—where for centuries small-scale traders have navigated the pathways that now feed into the Karakoram Highway—is already busy with traffic despite the absence of paved roads.

We thus argue that routes in High Asia provide tangible materializations of spatial encounters on different scales, past and present. We imagine these routes in the borderland of Afghanistan, China, Pakistan, and Tajikistan as part of a larger web, or a "texture of interwoven threads" (Ingold 2011, xii), that is neither confined by the nation-state nor determined by hierarchical differentiations between global and local. Rather, routes in this part of High Asia are—in scalar terms—lines that are connected to each other to different degrees and across various types of movement and transport.

Notes

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2. See, for example, E. Callahan 2013; T. Callahan, 2007; Dor 1975, 1979; Finkel 2013; Ispahani 1989; Levi-Sanchez 2017; Shahrani 2002.

3. See, for example, Bender 2001; Cresswell 1996, 2004; Escobar 2001; Feld and Basso 1996; Lefebvre 1991; Low and Lawrence-Zuniga 2007; Reeves 2011; Saxer 2016; Turton 2005.

4. Mostowlansky began ethnographic fieldwork and archival research on road construction in Tajikistan and Kyrgyzstan in 2008, in Pakistan in 2012, and in Afghanistan in 2016. The material presented here derives from interviews and participant observations, as well as from archives in Bishkek, Karachi, and Khorog. Marschall's contribution is based on his ethnographic fieldwork in the Wakhan between 2015 and 2019. In addition, we conducted several weeks of joint ethnographic fieldwork in the Wakhan in 2016 and 2019 (see Marschall and Mostowlansky 2019).

5. See Barfield 2010, 146–154; Saikal 2012, 31.

6. See Anderson 2005; E. Callahan 2009, 2013; Dor and Naumann 1978; Finkel 2013; Kreutzmann 2003; Leithead 2007; Shahrani 2002.

7. See, for example, Baptista 2018; Dalakoglou 2017; Khan 2020; Mostowlansky 2017; Snead, Erickson, and Darling 2009.
8. See, for example, Dzhumaev 1984; Ismoilov 1962; Nazrulloev 1979.
9. See Kotkin 1997; Siegelbaum 2008a.
10. See Clover 2017; Gibson 2016; Panda 2017; Snow 2017.
11. See Ispahani 1989; Karrar 2019; Karrar and Mostowlansky 2018.
12. See Mostowlansky 2018, 2019, and 2020.
13. See, for example, Allan 1989; Kreutzmann 1991; Kamal and Nasir 1998; Rippa 2018.
14. See Fontanari 2018, 2019.

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CHAPTER NINE

Motorbike Taxi Drivers, Ride-Share Apps, and the Modern Streetscape in Vietnam

JESSICA LOCKREM

Ho Chi Minh City is a metropolis of motorbikes. In 2016, there were 8.5 million motorbikes among the eight million people in Vietnam's economic capital (*Thanh Nien News* 2016). A Vietnamese expression illustrates the necessity of the motorbike for mobility: *không xe máy, không chân* (without a motorbike, without legs). Those who have motorbikes cannot imagine why anyone would choose to walk or travel by bicycle or bus. Those who do not, speak of their hope to get one. Members of the wealthy elite might drive a car or even employ drivers for their luxury automobiles. Those who can afford neither car nor motorbike might travel by bicycle, be transported by family members or friends, ride a bus, hire a car taxi, or go by motorbike taxi.

One major transportation planning study estimated the number of motorbike taxi drivers in Ho Chi Minh City to be in the tens of thousands (Almec Corporation 2004). Indeed, they are ubiquitous on the sidewalks of the city's inner districts. Particularly in the central business district, one does not need to walk more than a couple of blocks to find drivers perched on their motorbikes, ready to take customers to their destinations for as little as two dollars.

Recently, new actors have emerged alongside motorbike taxis: ride-share apps. Silicon Valley–based Uber and Southeast Asia–based Grab have set out to disrupt the taxi industry in Vietnamese cities. While other authors have examined these changes in terms of economic trends and business profits, this chapter examines motorbike taxi infrastructure and the introduction of ride-share apps at the scale of the street, through changes in drivers' practices and in their neighborhoods. Ride-share apps have begun to alter the landscape of motorbike taxis, affecting who is driving, who is riding, and the mechanics of how they are doing so. Transportation provides more than the circulation of people and goods for economic activity: it also shapes neighborhoods, lives, and how residents interact with one another. Transformations in transportation systems subsequently affect urban space. This study focuses on the scale of operators to analyze the impact of transportation infrastructure on communities.

This chapter is based on ethnographic fieldwork in Ho Chi Minh City from January to December 2013 and shorter field research trips in 2006, 2010, and 2016.[1] I conducted participant observation and more than a hundred semistructured interviews with motorbike taxi drivers on street corners, at regional bus stations, and at the train station. I also conducted participant observation at a local transportation planning research institute, and I interviewed planners, including Vietnamese and foreign experts, working on major public transportation studies. In 2016, after Uber and Grab had both begun operating in Vietnam, I conducted interviews with Uber and Grab drivers and observed them on the city streets. (Throughout, to distinguish drivers who use a ride-share app from those who do not, I use the descriptors "Grab and Uber drivers" versus "motorbike taxi drivers.")

I build upon this fieldwork by examining how the infrastructure and technology of motorbike taxis inform how they occupy public urban space. Because motorbike taxi drivers spend many hours on the streets to find passengers, they fulfill more than just the mobility needs of passengers: they also participate in infrastructures of security, order, and information. Recently, ride-share apps have allowed for new drivers to profit from transporting passengers and have changed how drivers gain customers—now this is done through the ping of a smartphone. If Uber and Grab disrupt the motorbike taxi industry in Ho Chi Minh City, how might this change the urban landscape? I argue that Uber and Grab drivers embody a modern relationship with public urban space that the state has been working toward for decades.

Motorbike Taxi Drivers as Infrastructure

In 2004, when 78 percent of trips taken in Ho Chi Minh City were by motorbike, the city's People's Committee set a goal of increasing public transit usage from 5 percent to 50 percent of trips in less than a decade (Almec Corporation 2004). In the course of my research in 2013, I spent time in the offices of transportation firms working to achieve that goal through the planning and construction of two urban rail lines, the first such lines in the city. While I observed transportation planners using massive amounts of data from surveys and traffic observations to map rail routes and station locations, I was struck by how efficiently motorbike taxis served the city's transportation needs without central oversight or expensive new physical infrastructure.

The transportation planners spoke about motorbike taxis in two main ways. First, they acknowledged that the motorbike was a convenient mode of transportation, one that city residents would not easily abandon for rail transport. Second,

they acknowledged the importance of the motorbike taxi for the so-called last mile between the rail station and the passenger's destination. Indeed, motorbike taxi drivers are an integral part of Ho Chi Minh City's transportation infrastructure. Drivers are spread throughout the city, picking up passengers as they leave shopping centers, or responding to text messages from regular customers. Hundreds of motorbike taxi drivers can be found each day at regional bus stations, awaiting riders arriving from the surrounding provinces who cannot afford a car taxi. Drivers might transport a child to and from school each weekday, or take an elderly person to a weekly medical appointment. Drivers fortunate enough to sit on corners in touristy areas hope for a foreigner who can be convinced to pay more. When drivers are not with a passenger, they recline on their motorbikes, relaxing, observing, smoking, drinking iced coffee, napping, reading the newspaper, and calling out to potential customers.

These drivers are filling gaps left by inadequate public transportation, forming an example of "people as infrastructure" (Simone 2004), whereby people flexibly step in where state-planned infrastructure is lacking. AbdouMaliq Simone developed this concept based on his research in African cities, observing "half-built environments" where the infrastructure is "underdeveloped, overused, fragmented, and often makeshift" (425). Motorbike taxi drivers in Ho Chi Minh City fulfill a similar need for transportation for the poor that the city is not currently able to meet through public or other low-cost transport. Serving an estimated 5 percent of trips in the city, based on the last major transportation study (Almec Corporation 2004), the public city bus system is not a widely used form of transportation. Like all bus systems, it does not provide door-to-door transportation, and the transportation planners I observed often cited this as a hindrance to increasing the use of rail or bus transit. Particularly in Ho Chi Minh City, the system is not able to reach many areas where the roads are too narrow for buses or even small automobiles.

Motorbike taxis in Ho Chi Minh City exemplify an "incessantly flexible, mobile, and provisional" (Simone 2004, 407) infrastructure. Whereas roads and the public city bus system are largely planned by a central authority, and the car taxi industry is regulated by the city, motorbike taxis have a history of emerging organically where there is need. Busy areas, such as stations serving as hubs for buses from surrounding provinces, can support hundreds of drivers. An intersection in a downtown area might have eight drivers who rotate in that spot throughout the day, while a corner in a remote district might have two drivers. I interviewed drivers who had been serving the same corners for up to fifteen years. Others might sit at different corners depending on the time of day and availability of customers.

Disorder and the Vietnamese Streetscape

The flexibility of the motorbike taxi makes it an effective infrastructure, yet from the view of transportation planners, this flexibility is disorderly. Despite their integral role in transportation for many residents, motorbikes (particularly motorbike taxis) are not compatible with the state's efforts to create modern streetscapes. The Vietnamese state has practical reasons for wanting to create an orderly streetscape: namely, reducing traffic congestion, which is feared to impede economic growth and increase pollution, and fostering the image of an efficient city, which is hoped to encourage foreign investment. While residents have supported the city's efforts to clear the sidewalks of vendors and sidewalk cafés in the name of modernity (Harms 2012), viewing sidewalk vending as dirty, disorderly, and a nuisance, this opinion is not as widespread in Vietnam as it is elsewhere, partly because many Vietnamese enjoy buying snacks and eating meals on the street (Kim 2012).

Scholars have demonstrated that streets around the world are increasingly designated to fulfill the primary function of mobility, particularly for automobiles, in the name of modernist urbanism.[2] Efforts in Hanoi to outlaw cyclos (in some ways, the predecessors of motorbike taxis) were intended to create a "modern" cityscape, eliminating the "backward" elements of informal-sector activities (Drummond 2000, 2384–85). In Ho Chi Minh City, "behind the search for smoothly flowing traffic lurks a civilizing mission" (Harms 2011, 191). Cyclos and motorbike taxis do not fit the state's goals of automobility and modernity.

The Vietnamese state associates modernity with law and order, while motorbike drivers regularly flout the rules of the road. Transportation planners, both local and foreign, often remarked to me that motorbike drivers were disorderly. One German transportation engineer, speaking to me about his research on road capacity analysis, claimed that driver behavior in Vietnam was "different from our countries, for sure." He spoke about the "undisciplined" behavior of motorbike drivers. Another interlocutor, a local transportation planner working on traffic models in Vietnamese cities, wrote that motorbike drivers travel in "erratic and chaotic trajectories." Planners who use words such as "chaotic" and "undisciplined" are not offering value-free observations. They demonstrate what Junxi Qian (2014, 13) notes regarding China, that "the flexibility of motorcycle movements contradicted the entrenched notion of ordered urban traffic." The materiality of the motorbike (that is, its small size and two wheels) means it can move through the city more flexibly than a car can, and, therefore, the state sees the motorbike as something that needs to be controlled.

Ho Chi Minh City has constructed material infrastructures to limit the chaotic mobility of the motorbike. Curbs, lanes, one-way streets, and medians are elements of the built environment that transportation planners have instituted to create order in traffic (Truitt 2008, 2013; Harms 2011). Motorbike drivers regularly defy these elements, climbing over curbs and onto sidewalks to get around traffic jams, driving down one-way streets in the wrong direction, swerving through oncoming traffic to move over to the right-hand lane, and maneuvering through small breaks in cement medians to make U-turns. The agility of the motorbike means that it has speed (Sopranzetti 2014); it also means that the state cannot easily restrain the motorbike to create an orderly street.

Speed is not the only attraction for the motorbike owner. The motorbike is a symbol of new individual freedoms and economic reforms in late socialist Vietnam (Truitt 2008), as well as of "new hedonist values, a shift from a culture of discipline towards a culture of pleasure" (Freire 2009, 73). Motorbike taxi drivers are assumed to be some of the worst violators of traffic laws, a statement I came across often in conversations with residents. Indeed, I came to expect that motorbike taxi drivers would disregard the rules of the road when they became inconvenient. On one ride, my driver, Mr. Hoa,[3] drove on the sidewalk, in the wrong direction, and in lanes reserved for four-wheeled vehicles—all in the first five minutes of the ride. It was faster to do so. Indeed, motorbike taxi drivers take pride in flouting the conventions of orderly traffic. Driving on sidewalks or over medians gives them the feeling that they have command over their motorbikes and over the city streets. They take pride in dominating the roads. The roads are the domain of motorbike taxi drivers, their arena of expertise, the place where they are in control.

Yet these drivers are associated with disorder for more than just their driving behavior. Their very presence on the street corners of the city makes them an aspect of urban disorder—much in the same way as the state views street traders as elements of a backward subsistence economy who are hindering the state's efforts to achieve modern, rational economic development.[4] The Vietnamese state has worked to present Vietnamese cities as modern, civilized, and ordered, and their economies as rational and under the control of the state.[5] The lower-class status of motorbike taxi drivers adds to their association with disorder. Furthermore, their customers belong to the lower and lower-middle classes (Vu and Mateo-Babiano 2013). Motorbike taxi drivers and street traders are private entrepreneurs using public space for private gain, without being taxed or consistently regulated by the city. Thus, they are a visible indicator that the state does not have control over the economy or over urban space.

Urban scholars have argued that the state needs to rethink mobility and traffic in a more humane way, framing inclusionary transportation planning efforts as

issues of urban spatial justice and the right to the city.[6] In Vietnam, mobile food vendors and motorbike taxi drivers depend on being able to use public space for income. Harassing and fining drivers threatens their livelihoods. While city officials have not been as aggressive at banning motorbike taxi drivers as they have been toward food vendors, some drivers described mild harassment from police, sometimes resulting in parking tickets for waiting on sidewalks. This practice is similar to other entrepreneurial sidewalk activities that are illegal but in practice are tolerated and only sporadically fined.[7]

Rather than banning motorbike taxi drivers outright, city officials have attempted to organize them: registering them, keeping lists of their names and license numbers, issuing uniforms for them, and circumscribing where they may wait for passengers. How closely motorbike taxis are regulated by the city varies depending on location. At the time of my research, station authorities at busy transportation hubs maintained control over who was permitted to wait for customers, and either charged the drivers fees or required them to direct traffic in lieu of paying a fee. In terms of daily operations, the drivers organized among themselves. For example, at the bustling East Bus Station, serving both regional and local buses, the security manager in charge of overseeing motorbike taxi drivers showed me a list of 410 drivers registered at the station. The list was divided into five groups according to where drivers were allowed to approach passengers. Drivers in each group paid fees to the bus station, wore uniforms, and set their own rules for how to approach and share passengers. One driver described the atmosphere before the registration system was implemented as lacking order, with drivers often getting into fights over passengers.

Although the administrators in the bus station offices collected the drivers' fees, approved new drivers, and maintained lists of registered drivers, the drivers themselves managed how they shared customers. For one group at the East Bus Station, this system centered on the driver board. The board was displayed on a pole above some benches in the drivers' waiting area. Metal clips, each with a different driver number, hung on wires draped across the board. Precisely every fifteen minutes, one of the drivers grabbed a pile of either green or yellow armbands from the desk and started calling off the first ten numbers from the board. As his number was called, the driver stood and grabbed an armband, put it on over his uniform, and headed out to the pavement to approach passengers.[8] Any drivers who did not find customers within those fifteen minutes returned to the waiting area and deposited their numbers on the board to wait for another chance.

The system benefited the drivers in many ways. It was more efficient and comfortable to have a smaller group of drivers trying to approach customers at any one time. Drivers did not need to yell over or jostle one another to get to the front

of a large group. Attempting to gain customers was therefore a calmer, less aggressive task. When it was not their turn, drivers were able to take a break from the sun and from standing or jogging after buses.

Some motorbike taxi drivers in District 1, the central business district, were part of a more formal self-managing security and order program. This program was devised to protect passengers from unscrupulous drivers and to ensure safety within the neighborhood by empowering drivers to maintain security. Drivers in the program wore olive green helmets with bold yellow lettering that included a four-digit driver number and a phrase meaning "self-managing security and order." They also wore a uniform: a loose, light-blue, button-down shirt with a yellow emblem including a Vietnamese flag on the upper arm. Above the emblem were the words "Liên đoàn lao động Q. 1" (District 1 Labor Union), and underneath that "Nghiệp đoàn xe ôm Phường Bến Nghé" (Ben Nghe Ward Motorbike Taxi Driver Union).

Elsewhere, motorbike taxi drivers largely operate outside of city regulation. Rather than operate under a central authority with established rules, smaller groups of drivers on street corners have come to regulate themselves. For example, drivers in my neighborhood explained which drivers were allowed to "fish" for passengers in which area. These rules of the street were made clear to me early in my research in 2013, when I accepted a ride from a motorbike taxi driver driving past my new home, only to incite a verbal kerfuffle between him and a driver perched on the nearest corner. This ended with the driver who had the unwritten right to the sidewalk revving his engine and driving into the other driver. Months later, after I had spent many hours getting to know my neighborhood drivers, I asked the local driver about the incident. He explained that the other driver was not supposed to approach prospective passengers on this street. Lack of central planning does not mean there are not rules among drivers.

Community, Information, and Order

Motorbike taxi drivers fulfill roles in the city that concrete and steel cannot. They are "quintessential urban figures" (Hansen and Verkaaik 2009, 6), residents who have a special knowledge of the city and who command resources that are crucial to its functioning. Drivers are embedded in neighborhoods, creating community, providing knowledge by giving directions, and serving as informal security in public space.

They have a personal stake in the well-being of their communities that is evident in how they conduct their work. When I asked drivers how they had come to sit on a particular corner, they often described being no longer able to work in

construction or other physically demanding jobs, and a neighbor inviting them to join other drivers at their corner. I asked one driver why he would invite a friend to join his territory if there were already so many drivers there, with apparently few passengers. He looked at me with a bit of disbelief and said that if you have two bowls of rice, you give one to someone in need. If someone needs a job, you let them join you, even if the passengers are then divided among a greater number of drivers. Drivers also told me stories of allowing drivers in need—perhaps someone whose family member had a new health issue, or whose student fees were due—to take additional passengers out of turn. I found drivers at the East Bus Station collecting funds among themselves to send to a driver who had to return to his home village after being injured in a collision. Such charity extended beyond the community of drivers: they gave free rides to high school students arriving in Ho Chi Minh City for college entrance exams, recognizing that these students did not have the money to pay for a ride. I observed many such acts of caring for the community during my fieldwork, something that initially surprised me because of drivers' low daily earnings but that I came to understand as reciprocity within communities.

Motorbike taxi drivers also play a role in maintaining security in their neighborhoods. One driver, Mr. Hung, a member of the self-managing security and order program in District 1, told me that the local security police (*công an*) had issued him his helmet, shirt, and driver number as a way for them to more easily manage drivers and protect passengers. When I asked about the drivers who did not wear a uniform, which was far more common throughout the city, and gestured toward a driver sitting nearby, Mr. Hung explained that the police occasionally ask to see their papers to ensure that they are registered drivers. If the police find drivers who are not in the organization, then the police may suspect that they live in other areas and are attempting to pass as local drivers. Mr. Hung added that if a registered driver stole from a passenger, the passenger would know the driver's number, and the police could track him down. Mr. Hung warned me not to travel with a driver who did not have a badge, pointing to the emblem on his uniform. He cautioned that someone could pose as a driver but really seek to steal from passengers.

Mr. Hung also spoke about motorbike taxi drivers' roles in protecting the neighborhood. He appeared to take satisfaction in protecting foreigners and locals from crimes such as theft. "I entered the group to combat petty theft so that foreigners could come and visit," he told me in Vietnamese. "We have this organization to promote security and order." He remarked that drivers had directly intervened when they saw a theft. He attended monthly Ben Nghe Ward meetings as the leader of the motorbike taxi driver labor union, and he reported on the

drivers' activities such as helping to combat crime. In response, the police issued certificates of merit as appreciation. Another driver told me similar stories of protecting people from thieves. He described the time he chased a thief and retrieved a purse for a tourist. The security and order program in Ben Nghe Ward transformed the motorbike taxi drivers from a sign of the state's inability to control the street into a visible presence of the state, inscribed on their helmets and uniforms.

Motorbike taxi drivers even play an important role in preventing crime before it takes place. These men, who spend many hours on the same street corner each day, are integral to the neighborhood, and astute observers. Jane Jacobs (1993), writing about American cities, famously claimed that a neighborhood is safer with more "eyes upon the street." The more people are in the public space of the street and watching activities there, the more crime is prevented from occurring. She wrote: "This is something everyone already knows: a well-used city street is apt to be a safe street. A deserted city street is apt to be unsafe. . . . There must be eyes upon the street, eyes belonging to those we might call the natural proprietors of the street" (44–45). Jacobs argued that merchants at small neighborhood stores are especially good at fulfilling this role, for they are a constant presence, and they are motivated to keep the streets safe because doing so is good for business. She wrote of the importance for those who watch the streets to know the neighborhood and its people, and to be able to spot suspicious activity and those who do not belong.

Thus, by being present, motorbike taxi drivers discourage thieves who do not want to be witnessed stealing a purse or phone. Drivers often work ten hours or more a day, and even on particularly busy days, they spend many hours waiting on their motorbikes. Their ability to maintain an unobtrusive presence allows them to keep an eye on the activities of the street. They are not the police; they are of the neighborhood. It is their ambiguous status within the legal and social landscape of the city that places them in such an effective position as the eyes upon the street.

Motorbike taxi drivers are such good neighbors not only because of their watchfulness, but also because of their knowledge and chatter. In a very practical way, motorbike taxi drivers possess essential information about the city that is not otherwise easily found, even for long-term residents of neighboring districts. Whenever I spent a few hours sitting with drivers, there would inevitably be a handful of motorists who would stop to ask for directions. When arranging to meet someone, friends often told me to ask a motorbike taxi driver for directions once I arrived at a particular street. Dense networks of alleyways and opaque numbering systems make the knowledge of motorbike taxi drivers indispensable.

Drivers have also been conscripted explicitly to maintain traffic order at transit hubs. Rather than pay fees to pick up passengers at the East Bus Station, one group of drivers I observed directed traffic at the entrance to the station. The group supplied two drivers from 5:00 a.m. until 4:00 p.m. A white board hung near their territory and listed one-hour shifts over the following three days, with a driver's number and name assigned to each shift. At the beginning of each hour, a driver picked up a baton, donned a red armband with yellow letters spelling out *trật tự* (order), and walked to the station entrance to direct traffic.

At the train station, motorbike taxi drivers similarly took turns maintaining order in traffic. They also had red-and-gold armbands that read *trật tự* and carried whistles. Once, I observed an older driver blowing his whistle at two young people on a motorbike. They did not heed his directions to move to a different lane, and he became so angry at their defiance that he lightly slapped the driver on the arm. Here, as elsewhere, I noted drivers taking their responsibilities to maintain order seriously.

Ride-Share Apps and Disruption

Many of the benefits that motorbike taxi drivers provide within their own communities and at transportation hubs are a result of the time that drivers spend with each other and on the streets. To some people on the outside, this time represents idle hours that could be better used. In 2013, two transportation planners proposed a system whereby motorbike taxi drivers would be organized into larger collectives, dispatched from centers, and equipped with meters, much like traditional taxis (Vu and Mateo-Babiano 2013). The planners' reasoning was that if drivers were organized in this way, they could drive fewer hours per day, transport more passengers during the time they worked, and not spend so many unproductive hours on the streets. This conceptualization of a central dispatching system for motorbike taxi drivers sounds a lot like Uber or Grab, and by the time of my research in 2016, both Uber and Grab were operating in Vietnam.

These ride-share app companies have set out to disrupt the taxi industry in Vietnam. "Disruption" has become a hackneyed term used in entrepreneurial circles to describe how Uber and other technology companies are interacting with established industries—selling a cheaper product, less profitably at first, to eventually take over an industry (Christensen 1997). In Ho Chi Minh City, Uber and Grab aim to pull customers away from traditional motorbike taxi drivers and to attract new passengers, offering a new option for the tech-savvy members of the middle class who have access to smartphones.

In the process, Uber and Grab are creating communities of drivers that inhabit urban space differently and interact with the surrounding community in new ways. The smartphone technology of the ride-share app means that ride-share drivers do not need to spend many hours on the sidewalk looking for passengers, nor do they need to develop relationships with neighbors to guarantee regular customers. But because ride-sharing necessitates an expensive smartphone, ride-share drivers and passengers are noticeably wealthier and younger—an infrastructural inequality that, as incomes in Vietnam continue to rise, will disproportionately leave older, poorer motorbike taxi drivers behind.

In contrast to the business sense of "disruption," the word has very different connotations in social science research on infrastructure, where it signifies not innovation and profit making, but breakdown and decay. Infrastructure is visible only when it fails, whereas when it is running as it should, it fades into the background (Star 1999; Larkin 2013). This idea of visibility and invisibility characterizes the privilege of the Global North. In the Global South, where citizens struggle to improvise reliable transportation, water, and communication systems, infrastructure is more commonly foregrounded out of necessity (Graham 2010). This is the case even though decades of infrastructural neglect and austerity in the United States and Europe have proved that there is no longer a clear demarcation between the infrastructure-rich North and the improvising South (Howe et al. 2016).

Motorbike taxis have been one such improvisation in Ho Chi Minh City: when many people could not afford motorbikes and the city did not provide sufficient public transit, motorbike taxi drivers found their market. A motorbike taxi driver told me during my first interview at the East Bus Station in 2013—with a dozen other drivers nodding as he spoke—that with incomes rising, they were seeing fewer customers. At the time of my research in 2016, motorbike taxi drivers did not see Uber and Grab as threats, at least not yet. However, it is possible these ride-share apps will come to disrupt (in the entrepreneurship sense of the word) the motorbike taxi industry. In 2016, I observed ride-share apps altering how drivers interact with the streetscape and how they create community with one another and the surrounding neighborhood. Were Grab and Uber to dominate the industry, they would disrupt not only the motorbike taxi industry, but also the infrastructure of order, security, and knowledge that the motorbike taxi drivers have maintained.

Ride-share drivers inhabit urban space in a way that more closely resembles the modern ideal that the Vietnamese state has been attempting to create for decades. I observed Uber and Grab motorbike drivers in 2016, soon after they began operating in Ho Chi Minh City. Already, it was clear that ride-share apps were impacting

the use of space in the city. If ride-share apps eventually gain most or all of the motorbike taxi market, it may mean that drivers will no longer be a constant presence in communities, providing informal security, giving directions to countless lost drivers, or just being friendly neighbors. With major changes in transportation infrastructure, there are ripple effects in the social fabric of the city—in this case, the loss of important figures on the streets and important sources of income for many families.

The Uber and Grab apps in Vietnam are the same apps that one uses in the United States, Singapore, or anywhere else these companies operate. Using one of the apps in Ho Chi Minh City, I first indicated that I preferred a motorbike rather than a car. I then indicated my destination, and the app gave me an estimated fare. My Grab driver arrived at my location within minutes. This process is markedly different from the alternative process of walking to a street corner that has a motorbike taxi driver, describing the destination, and then negotiating a price. Many (though not all) drivers for Grab wear new, shiny green-and-white helmets bearing the Grab logo, and jackets with the same colors and logo. Once I noticed the jackets, I began to see the drivers seemingly everywhere in traffic.

Class differences between the two groups of drivers were particularly apparent when I asked one group about the other. Asked if they would consider driving for Uber or Grab, motorbike taxi drivers immediately said no. Some said that they had never heard of the apps. Others said that they heard there were high fees for driving with the ride-share companies—rumors that I found had circulated among many of the long-time motorbike taxi drivers. In fact, a smartphone is indeed a high barrier to entry for drivers who earn fifteen dollars on a particularly good day.

Conversely, when I asked the Uber and Grab drivers about the motorbike taxi drivers, they were often dismissive. Motorbike taxi drivers were not worthy of their attention; after all, they did not share the same customer demographic. Ride-share drivers did not see themselves as similar to those older drivers. A few, though, told me rumors (always second- or third-hand) of motorbike taxi drivers becoming aggressive. According to the stories, a Grab driver would pull up to a customer, perhaps on the same corner as a waiting motorbike taxi driver, and the motorbike taxi driver would get angry, even physically aggressive with the Grab driver. When I asked a group of motorbike taxi drivers at the East Bus Station about these stories, they denied that such things would ever happen. The rumors propagated a sentiment I heard often during my research, one found in many newspaper articles about motorbike taxi drivers: they are disorderly, and one should be wary of their motives. These assumptions are steeped in classism. While groups of motorbike taxi drivers trust one another, and many are a welcome part of neighborhoods, when they

are perceived as an undifferentiated, unfamiliar mass, they can arouse suspicion on the part of other drivers, the media, and residents.

Compared to motorbike taxi drivers, Uber and Grab drivers do not need to spend as much time in public space when they are not driving. Because passengers summon them through an app, some wait at home or in a coffee shop for passengers, rather than on sidewalks. On one trip, I walked out of my hotel to find my driver exiting the small convenience store next door, where he appeared to be an owner. Whereas many motorbike taxi drivers enter the business after leaving another line of work (most often they have been soldiers, construction workers, or truck drivers), the Grab and Uber drivers with whom I spoke also had other jobs or were university students. This further informs the nature of the drivers' communities: motorbike taxi drivers work together for years, for many hours every day, while Uber and Grab drivers often work part-time between other commitments.

However, Uber and Grab drivers are not completely absent from public space. These drivers do not wait at the same intersections as the long-time motorbike taxi drivers, nor would they be welcome to do so. However, they do gather in large groups in the busy central business district during the day. Outside of Bitexco, the tallest skyscraper in Ho Chi Minh City in 2016, I observed more than a dozen Grab drivers waiting together. According to my interviews, it is not uncommon for a motorbike taxi driver to have been posted at a particular corner for twenty years, but these ride-share drivers were new to the area. They were noticeably inward-looking—chatting with each other, and looking at one another rather than the neighborhood—since they did not need to keep a lookout for passengers.

Ride-share apps are not creating new opportunities for existing motorbike taxi drivers to work more efficiently, as the study by Vu Anh Tuan and Iderlina B. Mateo-Babiano (2013) had predicted the use of meters and call centers would do. Rather, they are creating part-time opportunities for wealthier youths who have access to smartphones and the desire to use them. Ride-share drivers do not need to form a community with one another or with the surrounding space to gain passengers, and thus they do not need to invest in neighborhoods or support infrastructures of order, security, and knowledge.

Conclusion

Motorbike taxi drivers have been essential to Ho Chi Minh City: their very presence helps the city function. They are found throughout the city, on street corners, at major transportation hubs, and within neighborhoods. They provide an important transportation service for anyone without a vehicle who needs to travel quickly

and relatively inexpensively. They provide vital knowledge by giving directions to countless lost residents and visitors; and because they are embedded in their neighborhoods, they create community, providing a reliable set of eyes upon the street and informal security in public space. Drivers are an integral part of their neighborhoods, blending in with residents, neighbors, and street vendors on densely populated streets.

Some motorbike taxi drivers find it grueling to be out for long hours and would appreciate a way to find more passengers, yet this is not the goal of every driver. Some enjoy the time they spend on the sidewalks, or at least view it as a better alternative than being at home. One driver, Mr. Hung, told me that though he received a pension, he became a motorbike taxi driver because it was good for him to get out of the house. At the East Bus Station, even though drivers worked fixed hours, I often saw them staying at the station and talking with friends long after their shifts were over, in no hurry to go home. Dispatching drivers from a central office would disrupt the community and friendship that drivers have created among themselves and the ways that they benefit the surrounding neighborhood.

The emergence of ride-share apps in Vietnam has begun to alter how this urban space is embodied. The motorbike, with its openness, allows drivers to interact freely with their environment. Motorbike taxi drivers must be receptive to those around them, to find passengers and make their living. In Vietnamese, to go by motorbike taxi is to *xe ôm* (literally, to go by hugging), because of the close proximity between driver and passenger. This nearness extends to the relationship between the driver and the neighborhood, an intimacy built up over many years. Motorbike taxi drivers fulfill unintended roles in neighborhoods—building community, relaying information, and keeping order.

Uber and Grab drivers, in contrast, interact mostly with one another rather than with the community. Ride-share apps do not completely cut the drivers off from neighborhoods, but they create a more fleeting relationship between drivers and their surroundings. Ride-share app drivers do not need to establish relationships with residents to find customers, and as a younger, wealthier group that serves a more middle-class customer base, these drivers are changing the class dimensions of how drivers relate to the city. If Uber and Grab continue to gain more passengers at the expense of motorbike taxi drivers not using the apps, Ho Chi Minh City's street corners may look very different in the future.

The state and transportation planners have tried to rein in the flexibility of motorbike taxi drivers—both the versatility of the motorbike, which allows it to more easily flout traffic regulations, and the practice of fishing for customers, which drivers largely regulate themselves and which allows expansive idle time—all in the name of order and modernity. While the state has not yet been able to

control motorbike taxi drivers' practices through regulations, the technology introduced by Uber and Grab is fostering the modern streetscape that the state has long attempted to create.

Notes

1. I thank Dominic Boyer, Erik Harms, Max Hirsh, Cymene Howe, Till Mostowlansky, and two anonymous reviewers for incisive comments, and Anna J. Barańczak and Jeanne Ferris for careful editing.
2. See, for example, Holston 1989; Scott 1998; Amato 2004; Truitt 2008.
3. Pseudonyms are used throughout.
4. See Leshkowich 2005; Lincoln 2008; Harms 2009, 2012; Kim 2012, 2015.
5. See, for example, Lincoln 2008; Harms 2012; Schwenkel 2012.
6. See Lefebvre 1991,1996; Czeglédy 2004; Blomley 2007; Richardson and Jensen 2008; Soja 2010; Harvey 2012; Qian 2014.
7. See Leshkowich 2005; Lincoln 2008; Kim 2012; Turner and Schoenberger 2012.
8. I use male pronouns because I observed only one woman motorbike taxi driver among the hundreds of men drivers at the East Bus Station, and I did not observe her seeking customers with this system.

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CHAPTER TEN

Technical Experts and the Production of China's Airport Infrastructure

MAX HIRSH

On a crisp fall afternoon in 2018, I joined a delegation of airport planners, managers, and engineers on a construction tour of Daxing International Airport, a new hub being built sixty kilometers south of Beijing.[1] The group included a dozen employees of a French engineering firm that had developed Daxing's masterplan, as well as an American delegation whose members were eager to establish trade agreements between Daxing and Atlanta, the largest hub in the United States. Journalists from the government's mouthpiece, *China Daily*, tasked with writing a front-page article about the impressions of Daxing's "foreign friends," accompanied us on the journey to Beijing's rural outskirts (Du 2018).

Upon reaching the entrance to the construction site and taking in the airport's vast scale, the delegates let out a gasp. "On your right are the future headquarters of China Southern and China Eastern Airlines," our tour guide announced, pointing to two identical gargantuan office complexes. The bus accelerated onto an elevated highway. Workers squatted along its edges, armed with trowels and buckets of cement. "Here you can see the terminal," the guide continued. "It will be served by four runways and will have a capacity of forty-five million annual passengers. This will increase to a hundred million passengers and seven runways by 2040. OK, we are here."

As we exited the bus, airport staff members led us into a meeting room to watch a short introductory film. The room featured a prominent photograph of Xi Jinping, gesturing approvingly at a scale model of Daxing. The delegates snapped photos of the film with their phones, while the journalists took pictures of the "foreign friends" taking pictures of the film. "Now we will visit the construction site," the guide said. "Please be careful." Airport staff distributed hard hats while the guide shepherded us to an observation deck inside the terminal. "As you can see," she said, "Daxing is shaped like a human hand. Each finger of the terminal has gates on either side. The maximum walking distance to any gate is eight minutes. So it is better than the existing Beijing Capital Airport." The guide bravely continued her presentation, but it was difficult to compete with the scenery (figure 10.1). Dozens of delegates took selfies with the two tied-arch bridges that

Figure 10.1. Aviation professionals visit the construction site at Beijing's Daxing International Airport. (Photograph by Max Hirsh.)

flanked the departure hall below. A French engineer tugged on my jacket sleeve: "Look at these bridges! They are so wide, they could span a river." To my right, the delegates from Atlanta gazed at a giant Chinese flag hanging from the oculus where the terminal's five piers converged, shaking their heads in disbelief. "This is crazy, man," one of them exclaimed. "Not what I expected of China. Everything is just so . . . wow. Just crazy."

Recent scholarly work on China has devoted much attention to policy directives aiming to export a so-called China Model of infrastructure-led development to countries in Asia, Africa, the Middle East, and the former Soviet sphere.[2] To promote that model abroad, the People's Republic of China (PRC) has directed considerable manpower, technical expertise, and financing to the overseas construction of roads, rails, pipelines, seaports, and airports. These projects aim to drive urban development, economic growth, and regional integration in emerging

and middle-income economies, while at the same time cementing diplomatic ties with China. The scale, speed, and overt geopolitical objectives of these projects have captured the attention of the public, as well as that of policy makers and scholars around the world.

However, less attention has been paid to the origins of that infrastructure-led model, which forms the centerpiece of the Chinese government's Belt and Road Initiative. This chapter addresses that gap by studying the development of China's airport infrastructure from the 1980s to the present. I posit aviation as an insightful lens through which to trace the influx into China of infrastructural expertise from Europe, Japan, and North America during the post-Mao period of Reform and Opening Up. Drawing on fieldwork at airports in Mainland China, Hong Kong, France, and the United States, as well as on interviews with architects, planners, and engineers, I trace the transnational origins of China's infrastructural expertise in order to better understand the processes by which the China Model of infrastructure was subsequently exported (or rather reexported) abroad. By investigating how aviation professionals from around the world collectively created a particular set of airport planning practices, I argue that these midlevel experts played an indispensable role in China's reintegration into the global economy and its reengagement with the outside world. As such, they represent a crucial—and thus far overlooked—source of data for both infrastructure scholars and scholars of China.

With that in mind, the chapter focuses on a series of cooperative research, training, and development programs—organized jointly by Chinese, European, and US transportation agencies, airport operators, and engineering firms—that have fueled the production both of airport architecture and aviation technology on a global scale. By revealing untapped sources of empirical evidence, I ask: What are the spatial, aesthetic, and managerial outcomes of that process? How does it challenge received notions about the pathways of transnational knowledge exchange? And how does it help us to better conceptualize why infrastructure-led urbanization has become a defining facet of the China Model of development?

A note on methodology is in order at the outset. The chapter draws inspiration from historians of technology who devote equal attention to infrastructure's material, social, and regulatory components, none of which could effectively operate without the others (Edwards 2003). I am particularly indebted to Thomas Misa's (1994) analysis of infrastructure's social organization—the people behind the projects—which he divides into three scales: macro (top-level decision-makers), micro (local actors on the ground), and meso (experts and institutions that influence infrastructural outcomes by setting design standards and enforcing technical norms). I draw on ethnographic fieldwork to give voice to those experts—that is,

the architects, planners, and engineers who build large-scale transportation projects.

In the existing literature on Chinese infrastructure, the perspective of these experts is conspicuously absent. That omission can be attributed to the relative invisibility of the specialist firms where they are employed. While corporate architects and state-owned enterprises manage the public face of mega-projects, they rarely come up with the specific planning, design, and engineering guidelines upon which the projects are based. Meanwhile, the niche companies that perform these tasks typically maintain a low public profile and are not widely known outside industry circles. These professionals played a crucial role in the transfer of infrastructural expertise during the post-Mao era. By planning the vast majority of Chinese airports, they guided the development of a cross-border aviation system that critically underpins China's regional integration—and the integration of its goods and people into the global economy.

Engaging with those professionals reveals significant gaps between the theory and practice of infrastructure. As I have discussed elsewhere, scholars often analyze public representations of infrastructure to infer the intentions of its producers (Hirsh 2011, 2016). Yet much of the expert knowledge related to aviation—the nuts and bolts needed to move a project from the concept stage to implementation—is rarely written down. That information is commercially sensitive, and like many precious commodities, it is traded by word of mouth among trusted partners. To really understand how an airport gets built, I would need to get to know the industry from the inside out. I looked for opportunities to engage in the full production cycle of an airport project: participating in airport design competitions, leading workshops for airport authorities, delivering keynotes at industry events, and writing articles for trade publications. I also took part in countless discussions with airport managers, planners, and engineers to better understand the people behind the projects—how they got into infrastructure, what their goals are, and what motivates them to stay in the field.

The chapter thus investigates the genesis of China's airport infrastructure through an ethnography of its producers. Specifically, I study how foreign firms interacted with Chinese aviation and urban planning institutions, and how their design schemes were adapted to China's spatial and regulatory norms. I begin by charting the activities of one French engineering firm in order to highlight the multiple ways by which infrastructural expertise entered China during the period of Reform and Opening Up. I expand on this theme by focusing on two specific pathways of technical exchange: development aid and professional training. Finally, the case study of Shanghai Pudong International Airport demonstrates how different sources of design and technical expertise from France, the United States,

Japan, and China coalesced in one very influential project. In the chapter's conclusion, I consider how these findings can stimulate new conceptual and methodological approaches to the study of infrastructure.

Building the Chinese Riviera

In 1989, the French airport authority Aéroports de Paris (better known as ADP) hosted a delegation from Hainan at its headquarters in Paris (Le Masson 2017; Tamisier 2017). Previously an administrative region of Guangdong, Hainan had recently been elevated to the status of province by the central government, which also designated the entire island as a special economic zone, or SEZ (Yang 1988). Like other SEZs in southern China, Hainan's output goals focused on export-oriented industrial and agricultural activities, such as mining iron ore and cultivating rubber, pepper, and coffee. But the Hainan SEZ was also established to stimulate China's nascent tourism industry. As Pál Nyiri (2010) has noted, in Maoist China, tourism was seen as evidence of a bourgeois lifestyle and was therefore taboo. But in the 1980s, the government reversed that position through a series of policies that promoted the development of "scenic spots" and encouraged both overseas visitors and Chinese citizens to engage in leisure trips. With its tropical climate and sandy beaches, Hainan appeared to be an ideal place to start. During the spring festival of 1987, the provincial government announced its intention to develop Hainan's Yalong Bay into a "tropical international tourist area" and to allocate considerable resources to the construction of a new airport in Sanya (Hu 2012).

The Hainanese delegation was assigned the undoubtedly pleasant task of traveling abroad to study examples of successful tourism regions. Their tour led them to two conclusions. First, all destinations that they visited relied on aviation to attract large numbers of leisure travelers. Second, they identified the French Riviera as the gold standard of seaside tourism. They were particularly impressed by Nice's Côte d'Azur Airport, which had opened a second terminal in 1987 (designed by ADP). Developing a Chinese Riviera in Hainan, modeled on the French precedent and anchored by a modern airport hub similar to the one in Nice, became the delegation's top priority.

Hence the visit to ADP and the meeting with two of the firm's architects, one a leading figure in French design culture, the other a recent hire in his mid-thirties. Paul Andreu is perhaps best known as the architect of Charles de Gaulle Airport (1974) and for his role in designing the Grande Arche (1989), the striking centerpiece of Paris's La Défense business district. His younger counterpart was François Tamisier, a graduate of the École des Beaux-Arts who began his training as a sculptor before transitioning to architecture. Tamisier joined ADP in 1987 to work

on the Grande Arche. Unlike Andreu, Tamisier had no previous experience in airport design. And while ADP had successfully won a contract to build Jakarta's Soekarno-Hatta International Airport, completed in 1985, the company's footprint in Asia remained small. When Hainanese officials invited ADP to submit a proposal for an international airport in Sanya, Andreu and Tamisier leaped at the opportunity.

The goal of the project was to build a modern airport that could welcome international guests and establish Hainan as an attractive vacation destination. The airport was planned concurrently with and sited adjacent to the first Chinese location of Club Méditerranée, the French resort hotel chain. (In 2015, Club Med was purchased by the Chinese conglomerate Fosun. Its headquarters remains in Paris.) Construction for Sanya's Phoenix International Airport broke ground in 1990. When it opened four years later, it became the first Chinese airport dedicated to leisure travel (*Sanya Daily* 2018).

The successful inauguration led to a string of Sino-French aviation projects. Over the past thirty years, ADP has participated in the design and planning of many of China's largest hubs, including Guangzhou Baiyun, Shanghai Pudong, Chengdu Shuangliu, Chongqing Jiangbei, and Nanjing Lukou. Most recently, ADP partnered with Zaha Hadid Architects on the design of Daxing International Airport (Beijing's second hub), whose opening in 2019 was timed to coincide with the seventieth anniversary of the founding of the People's Republic of China (figure 10.2).

This brief foray into the history of one French infrastructure firm demonstrates two key points. First, Hainan is an unlikely point of entry into the Chinese market. Most discussions of cross-border infrastructural investments focus on how they are used to manage urban growth in first-tier cities or, alternatively, how they are deployed to increase industrial production and the extraction of raw materials. With airports, that perspective is problematized by the fact that much of China's initial infrastructural know-how entered the country via Sanya—an airport whose goal was to jump-start a new branch of the economy predicated on consumption and leisure.

Second, Sanya sheds light on a much broader phenomenon. In the post-Mao era, China has made staggering investments in transport infrastructure, developing highways, high-speed rail stations, seaports, and airports at a pace and on a scale that has captivated the imagination of observers both at home and abroad. Some scholars have pointed to the prevalence of engineers among China's ruling elite as one explanation for this infrastructure-oriented approach to economic development (Andreas 2009). Yet few have bothered to ask where the necessary infrastructural expertise that undergirds these projects actually originated.

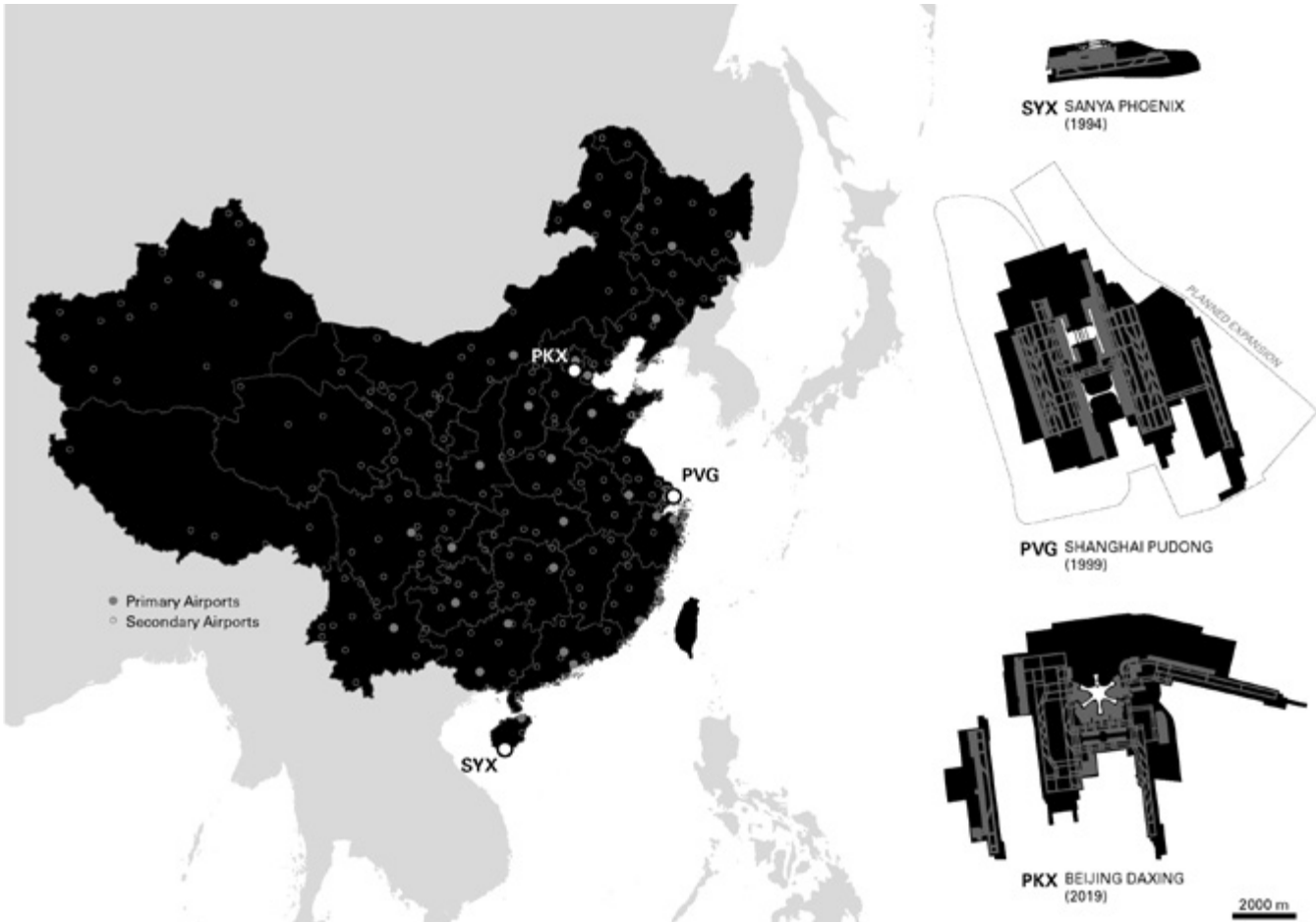

Figure 10.2. China's airport infrastructure. (Map by Dorothy Tang. Made with Natural Earth data.)

When Deng Xiaoping came to power in 1978, China had astonishingly few airfields. They remained under the direct command of the People's Liberation Army until 1980—when, in an effort to introduce a market-driven approach to air travel, the central government separated the Civil Aviation Administration of China (CAAC) from the military. The CAAC subsequently transferred the responsibility for airport operation to local governments, broke up the national airline into several smaller entities, and encouraged the development of private regional carriers to compete with state-run ones (Hirsh 2017). Despite these policy changes, civil aviation was slow to develop. China's airlines had little experience with commercial operations, and airport operators lacked basic knowledge about how to build airports and manage air traffic. In contrast to major hubs in Japan and the West, Chinese airports relied on a single airstrip (except for Beijing, which had two), as Chinese aviation planners did not know how to design a multi-runway system.

Fast-forward to the twenty-first century, when China routinely inaugurates four- and five-runway hubs capable of handling upward of a hundred million passengers a year. These airports are equipped with the latest biometric technologies, integrated with high-speed rail networks, and rolled out at a speed unthinkable in Western countries. During the 2016 US presidential election campaign, Donald Trump drew a comparison between "incredible" Chinese airports and "third-world" American ones to illustrate the growing trade imbalance and technological gulf between the two countries (Munzenrieder 2016). How did China acquire the necessary technical expertise in such a short period of time?

Two Pathways of Technical Exchange

An analysis of the aviation industry reveals two processes by which infrastructural know-how was imported into China during the post-Mao Reform and Opening Up era. The first was a coordinated effort by foreign governments to promote the use of their countries' technical expertise, equipment, and services in China. We can read those endeavors as an attempt to export a particular set of industrial norms, standards, and specifications, using large-scale transportation and telecommunication projects as a vehicle for establishing those norms in the PRC.

An American planner, for example, based on his or her own professional experience, is likely to be most familiar with US design and technical standards and will incorporate those standards into an airport's masterplan. In effect, the introduction of these standards is a form of upstream business development for a range of service providers who produce hardware and software used at airports—everything from elevators, escalators, self-check-in terminals, and biometric devices, to aircraft, airbridges, and air navigation systems. Establishing these norms

in emerging economies is essential for the economic survival of developed nations, whose voting publics grow both weary and wary of major infrastructure investments, and where building new airports from scratch has become rare. Amid stagnating domestic markets, advanced industrial countries depend heavily on the export of infrastructural goods and services to maintain growth. The macroeconomic impact of introducing specific norms and standards early in the design process is tremendous, and governmental agencies go to significant lengths to do so (Bradford 2020).

The technopolitics of infrastructural standards and their use as tools of bilateral diplomacy should not be underestimated (Barry 2001; Mitchell 2002). Introducing these standards during the start-up phase of an emerging industry presents opportunities to influence that industry's long-term development, while at the same time sowing the seeds of intertwined political and financial interests between the sending and receiving nations. In the domain of aviation, Western European nations, along with South Korea and Japan, stand out as the most active participants in that battle. In the Chinese context, France, Japan, the Netherlands, and the United Kingdom have arguably been the most prolific. They deploy a complex constellation of diplomatic entreaties, technical assistance programs, and cultural exchanges in order to advance the financial interests of their countries' planning and engineering firms, airplane manufacturers, and airport and airline operators. These firms, in turn, provide a foothold in China for homegrown products and services from related industries, such as those in the construction, hospitality, and food and beverage sectors.[3]

The development of airport infrastructure thus serves as a useful lens for studying China's broader reintegration into the global economy in the post-Mao era and its reengagement with its historical enemies. As Deborah Brautigam (2009) notes, beginning in the late 1970s, Japanese, American, and European governments supplied the PRC with advanced technical equipment and training programs, paid for by loans with attractive terms. These financial packages were often disguised as technical aid, with the understanding that this assistance would be used to purchase products and services from the lending country. The regular signing of memoranda of understanding and the professional gatherings that take place to mark those occasions represent the glue that hold these bilateral relationships together.

One example is the Sustainable Airport Areas International Seminar, a conference that I have participated in annually since 2012 (figure 10.3). Organized and largely financed by French government agencies and state-owned enterprises, the conference was initially founded to strengthen international relations and promote knowledge exchange among three of the world's largest airports: those in

Figure 10.3. Delegates at the 2018 Sustainable Airport Areas International Seminar. (Photograph by Max Hirsh.)

Paris, Atlanta, and Shanghai. The choice of cities was not coincidental. These three airports are hubs for Air France, Delta, and China Eastern, respectively—all members of SkyTeam, one of the aviation industry's big three airline alliances. Beyond the stated purpose to promote the international exchange of ideas, the conference is a place for Chinese clients to network with foreign service providers.

While the event is international in nature, typically half of the attendees are French. They include aviation professionals from Air France, ADP, and ADP's overseas planning and engineering subsidiary, ADPI. Also attending are representatives of aviation-related start-ups and economic development boards seeking foreign investment in France. Rotating among Paris, Atlanta, Beijing, and Shanghai, the conference has proven crucial for building and maintaining Sino-French relations in the sphere of aviation, while contributing to the coproduction of airport infrastructure and airport-area economic development in France, the United States, and China.

American architects, planners, and engineers often view Chinese projects as an uneven playing field, seeing themselves at a disadvantage compared to their European and Asian competitors. Much to their consternation, the US government has hewn closely to a "let the market decide" mentality, and has not provided

a comparable level of financial and diplomatic support for American firms attempting to enter the Chinese market. Reflecting on his experience working in design competitions in Beijing and Shanghai in the 1990s, Jeff Thomas—the former CEO of the Cincinnati-based aviation planning firm Landrum & Brown (L&B)—recalled: "We faced an uphill battle competing against the Europeans. They got into China before the US. The US first got in after the doors opened with Nixon in 1972. The Europeans were already in there then. They were much more aggressive in going forward and entrenching themselves" (J. Thomas 2017).

Another American airport planner expressed a more pointed critique: "The French go in there and just buy the project. How the hell are we supposed to compete? They cover the design fee and pass the work on to their own companies. It's corruption, pure and simple. No US administration will ever do that" (Interviewee A 2017).

The extent to which bilateral relations influence infrastructural outcomes in China—and in Asia more broadly—can be inferred from a story that was related to me by a prominent American architect:

> The day after we won [a major airport project], I was summoned to the US ambassador's office. I was expecting him to congratulate us on winning a big competition, maybe offer me a glass of champagne. Instead he was livid.
>
> "Who did you bribe?" he demanded.
>
> I was taken aback. "Uh, I didn't bribe anyone."
>
> "Don't play dumb with me," the ambassador shot back. "That airport was supposed to go to the French. I know everything that goes on here. Now who the fuck did you bribe?"
>
> The ambassador asked me three more times before he stormed out of the office. He just couldn't believe that we had won the competition based on our design proposal. (Interviewee B 2017)

These accounts testify to the common perception among US aviation professionals that they face unfair disadvantages in China relative to their European competitors. Yet by focusing exclusively on the subject of aid, these American architects and planners neglect to mention the influential role played by government-backed bilateral training programs—which represent a second significant pathway for the transfer of standards and norms.

The most notable of these programs is the US-China Aviation Cooperation Program (ACP), under which Chinese airport engineers and administrators are invited to the United States for technical training and study tours. Although ACP is funded by the Federal Aviation Administration and the US Trade and Development Agency,

the organization is chaired by the president of Boeing China, and its day-to-day operations are delegated to private firms like Boeing, FedEx, American Airlines, General Electric, and L&B, which organize visits to their own factories and run training programs out of their company offices (S. Thomas 2016). In effect, these training programs are an opportunity for American corporations to introduce their goods and services to a Chinese audience—a pitch meeting, if you will, funded with taxpayer money.

Since ACP was established in 2004, these courses have also enabled US firms to overcome yet another competitive disadvantage: their inability to pay bribes. Several European interviewees described the creative accounting methods that their companies had devised for giving gifts—an essential aspect of doing business in China. By contrast, my US-based interlocutors claimed that stringent federal antibribery legislation prevented them from giving gifts to their Chinese business partners. ACP offered a legal alternative by providing Chinese aviation professionals with all-expenses-paid study tours to the United States—tours which frequently doubled as extended shopping trips (Interviewee C 2017). One senior American airport planner who had hosted numerous ACP delegations confided that it was essential to schedule visits to high-end shopping centers, as well as more mundane runs to Costco, to keep the Chinese participants happy and receptive to doing business (Interviewee D 2017).

The start of the twenty-first century saw a flourishing of American and European aviation education initiatives on Chinese soil, with a French state institution—the École Nationale de l'Aviation Civile (ENAC)—once again playing a leading role. Since its founding in 1949, ENAC's primary mission has been to train aeronautical engineers and administrators, and prepare them for a career working for France's airports, airlines, and aircraft manufacturers. Beginning in the 1990s, however, the elite grande école took on an additional role: to train Chinese students and, in so doing, to bring up-and-coming aviation professionals into contact with French companies like Airbus and ADPI. While some Chinese students come to ENAC's home campus in Toulouse, the majority are enrolled in degree programs jointly offered by ENAC and partner universities in Beijing, Hong Kong, and Tianjin. In 2007 ENAC and the Civil Aviation University of China founded the Institut Sino-Européen d'Ingénierie de l'Aviation in Tianjin, and a larger Sino-French aviation university, based in Hangzhou, is scheduled to open in the early 2020s (Cooke 2019).

ENAC's initiatives are part of a top-down effort to inculcate French planning practices and integrate French companies and state institutions into all dimensions of airport production in China, including tertiary education. In effect, hundreds of employees of ADP, ADPI, ENAC, and Airbus operate in a coordinated

fashion, each seeking to find business opportunities for the entire French aviation sector. By contrast, American forays into Chinese higher education have been driven by individuals working on behalf of a single company: L&B. Thomas recalls that these efforts advanced primarily through entrepreneurial happenstance:

> L&B had a big office in Chicago. A friend of mine introduced me to a Chinese gentleman there. He was living in Chicago, but the family was out of Canton, and they were well connected. He didn't know much about airports, but he wanted to do things, you know? He kind of took us by the hand and tried to help me get into China. He got me in with all the officials in Guangzhou, and through that I met a bunch of people in [Shanghai] Pudong. But we were too late to the party: they'd already made all their choice[s] of the planners and designers [in Guangzhou], and we lost the competition [in Shanghai]. Then at some point he introduced us to the civil aviation university in Tianjin. We put a scholarship program together for next to nothing, and it's one of the best investments in anything I ever made. It was like five or six thousand dollars a year, and it was giving three or four kids a scholarship. Later they divided it up into partial scholarships for ten to twelve kids. But it's created an enormous sense of goodwill. These people are now in middle management at half the airports in China. And L&B helped pay for their education, so there's so much goodwill there. The first guy who got the scholarship was the first mainland employee we hired. (J. Thomas 2017)

This example is notable for two reasons. First, in contrast to the top-down forces and bilateral initiatives that drive European technical aid and professional training programs, relying on a well-connected Chinese middleman reveals a much more informal and entrepreneurial approach to the transfer of infrastructural expertise. At the same time, the role of that intermediary—who married the developmental ambitions of mainland clients with the financial objectives of foreign service providers—suggests an element of historical continuity, recalling the critical role that Cantonese compradors played in the introduction of new technologies into China in the nineteenth and early twentieth centuries.[4]

Building Shanghai Pudong International Airport

A case study illustrates where these different actors and knowledge exchange pathways intersect: completed in three stages between 1999 and 2008, Shanghai Pudong International Airport was developed by Chinese state planning and aviation authorities who relied heavily on technical, financial, and managerial

expertise imported from France, Japan, and the United States. Studying Pudong enables us to better understand the division of labor between them. It also highlights the influential role that Shanghainese models of urban and regional development played during the Reform and Opening Up era. Many of my interlocutors emphasized the city's vanguard status: according to the conventional wisdom among infrastructure planners, once Shanghai builds something, all other airports in China will follow (Goldberg 2017). In particular, Pudong helped introduce a broad range of technical and design standards into the field of Chinese infrastructure planning, while at the same time establishing the terms by which Chinese airport authorities and local design institutes work with foreign engineering and design firms. The collaborative model that Chinese and overseas planners pioneered at Pudong thus had powerful implications for China's aviation infrastructure as a whole.

Before proceeding, it is essential to point out two critical elements of Chinese planning that fundamentally determine the financing, spatial organization, and temporal framework of infrastructure development: the five-year plan and the National Development and Reform Commission. Imported to the PRC by Soviet advisors in the early 1950s, the five-year plan remains the basic building block of China's state-led economy (Xue and Ding 2018). Each plan includes a chapter on transportation infrastructure that summarizes the central government's main objectives for its road, rail, air, and sea networks, and that announces any major changes in the policies that govern the movement of goods and people to, from, and within Mainland China.

The critical element that determines how, when, and where aviation infrastructure is planned, built, and delivered is the National Development and Reform Commission, or DRC. Most of China's airports are owned and operated by municipal governments, which delegate the detailed planning and design work to their city's local design institute. Local officials—particularly mayors and Communist Party secretaries—are thus important decision-makers who influence both the process and outcome of airport development. Yet the real power to develop aviation infrastructure lies with the DRC, thanks to its ability to designate a given infrastructure project as a national-level priority, and to marshal substantial financial and political capital in the process.

It is within this organizational framework that the development of Pudong needs to be understood. In 1996, the Chinese government published the Ninth Five-Year Plan. Anticipating a doubling of China's aviation volume—from fifty-one million passengers and one million tons of cargo annually in 1995, to nearly twice that amount by 2000—the plan called for the development of forty-one major airports across the country (JICA 2001). Along with Beijing and Guangzhou,

the plan prioritized Shanghai as one of China's three international hubs, and it authorized the construction of a new airport to support economic growth in Pudong New Area, arguably China's most prominent showcase for urban development. Shanghai Pudong, as the new airport became known, was aimed to enhance the city's international connectivity, while the expansion of Shanghai's existing airfield at Hongqiao was intended to accommodate the increase in domestic flights.

Bearing those goals in mind, in 1996 the Chinese government commissioned Japan's International Cooperation Agency (JICA) to prepare a masterplan and detailed design study for the new airport, which was to be built on reclaimed land along Pudong's rural eastern coastline. JICA, in turn, assigned that task to Nippon Koei, Japan's largest engineering and construction consultancy, and Nikken Sekkei, an architecture and planning firm (JICA 1997). Both companies offered expert knowledge about airport-led land reclamation, which they had recently gained while building an artificial island, New Kansai Airport, in Japan's Inland Sea (Hirsh 2019). After the study's completion in September 1997, the Chinese Ministry of Foreign Trade and Economic Cooperation and the Shanghai municipal government entered into an official development assistance loan agreement with the Japanese government, administered by JICA. Under the terms of the loan, Japan lent China 40 billion yen (roughly equivalent to USD 330 million) to fund the construction of a four-kilometer runway, a 200,000-square-meter passenger terminal, and a 65,000-square-meter cargo terminal. Crucially, the loan covered the project's foreign currency costs, thereby overcoming the perennial challenge of moving money between China and the outside world.

Pudong's planners thus relied heavily on Japanese financial assistance and engineering expertise. Yet when it came to architecture and landscape design, they turned to a different source: France. In 1997, ADP won an international competition to design Pudong's passenger terminal building (T1), whose inauguration in 1999 would fall on the fiftieth anniversary of the founding of the PRC. Planned by a team led by Andreu, T1 rehearses the basic design elements of Charles de Gaulle's Terminal 2F, which Andreu's team was constructing concurrently in Paris. ADP was also tasked with developing a conceptual approach for the entire airport. Tamisier recalls:

> When we went on the site for the first time there was nothing: rice land with water and the sea. The plan was to silt up the land in order to create it. We decided to design a very large pond, with the main ideas as the water and the sky. In this way, we tried to bring in Chinese artistic elements. It is a large pond, four hundred meters by four hundred meters, and we used this as drainage. And we brought in the road coming from Shanghai across

> the water, to give the experience of taking flight. So the first image of the airport is: it was water, it will always be water. The second theme is architecture as a garden. We used these two elements for urban scenography. We followed the Suzhou Gardens with a yard, walls, and a square. We spoke of Pudong as a very large Suzhou garden. We thought that it was important to work with knowledge of Chinese culture, painting, and landscape arts. In China there are a lot of possibilities to create big areas starting from a small, specific site—for example, in Suzhou, or in the Forbidden City in Beijing. At the time Shanghai was the biggest airport in China. Our proposal had to be of an international standard and totally based on Chinese culture, so we considered the landscape as a very important system. Of course, we provided the standard masterplan, but with a mark: we are in China, and we have to express this. The main idea we used was the garden as a possibility to organize a very large amount of land following the Chinese system of building a plan around the void. (Tamisier 2017)

ADP's role in the construction of Pudong points to both the economic and aesthetic commonalities that connect Chinese infrastructure planners to their French counterparts. As Neil Fligstein and Zhang Jianjun (2010, 47) have argued, China's form of "organized capitalism" bears a strong resemblance to France's model of a coordinated market economy, wherein the private sector is dominated by state-controlled enterprises.

Discussions with my interlocutors at the Paris airport authority appear to support that thesis: several of them made comparisons between China's socialist market economy and France's dirigiste approach to capitalism. One executive at ADP told me that the Chinese "understand our way of thinking. For us, the airport is not just about aviation, it is also about promoting our national interests. There are many similarities between Chinese state-owned enterprises and our own companies. We understand the mentality" (Interviewee E 2016). This attitude helps explain the willingness of the French diplomatic corps to intervene on behalf of French companies, as well as its ability to provide financial incentives (an ability that goes beyond that of most other nations) to favor the outcome of airport design competitions.

But beyond the level of economic policy, Sino-French infrastructural cooperation is bound together by obvious aesthetic affinities, in particular a fondness for large-scale territorial planning based on abstract metaphors. Formalist design concepts, predicated on dubious references to feng shui and purported Chinese design traditions, forge an epistemological connection between the objectives of Chinese government officials and those of French planners and engineers.

This is evident in ADP's conceptual approach to Pudong, and in the rhetoric commonly deployed by Chinese government officials to justify major infrastructure investments. The recourse to abstract formalism was evident at a Sino-French aviation conference held in Beijing in 2018. The event marked the one-year countdown to the opening of Daxing International Airport. In one of the opening speeches, a senior airport executive discussed the formal similarities between the older Beijing Capital International Airport and a dragon. That airport's presence on the eastern periphery, he explained, had thrown Beijing's urban development out of joint. The inauspicious situation would be remedied through the construction of the new airport at Daxing; occupying a site shaped like a phoenix, Daxing would restore balance to the Chinese capital and guarantee the harmonious development of the greater Jing-Jin-Ji region (Kong 2018).[5]

Metaphorical formalism is likewise a common facet of the many follow-up projects that ADP has won as a result of its work at Pudong. One French architect, for example, framed ADP's development plan for Nanjing's Lukou airport as a "modern airport city inspired by the traditional Chinese city" (Leymarie 2018). Its network of gridded streets, bookended by triumphal gates, echoed the "square frame" and sequence of "doors and thresholds" characteristic of premodern Chinese urbanism, while a rectangular water feature, studded with two islands connected via four bridges, referenced the interplay between water and energy and between the real and the reflection of Nanjing's Xuanwu Lake (figure 10.4). A series of circular office towers—set along an axis that one might be forgiven for interpreting as a paean to Ludwig Hilberseimer's vertical city—was in fact a nod

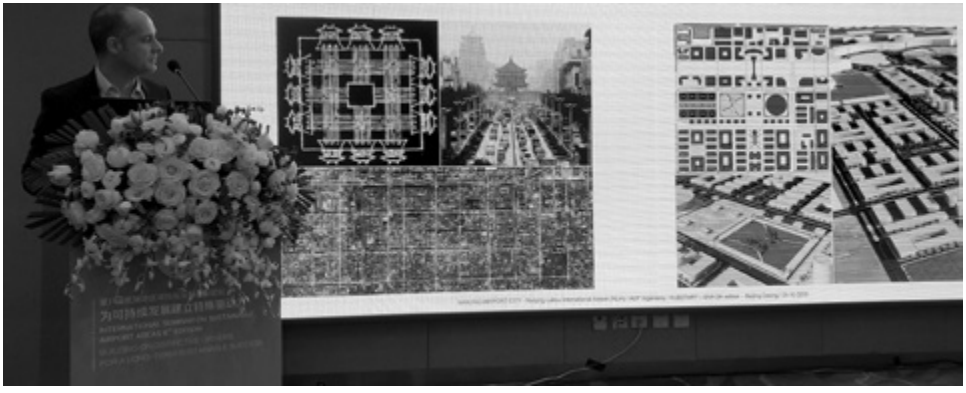

Figure 10.4. A French architect explains the design concept of Nanjing Lukou International Airport. (Photograph by Max Hirsh.)

to the *tanggu,* the traditional Chinese drum, whose rhythm marked the flow of time and bound the past to the future.

French designers evinced a talent for engaging with two countervailing tendencies typical of the late-twentieth-century Chinese client: a hunger for foreign designs as a way to demonstrate China's modernization and ascendance, coupled with patriotic homages to tradition (many of them dubious) that deliver that modern infrastructure in a Chinese register. Firms like ADP, however, proved less adept at adapting their design schemes to the practical needs of the burgeoning Chinese aviation market. They underestimated, in particular, the rapid growth in air traffic that quickly rendered their initial designs incapable of accommodating the volume of passengers at one of China's largest hubs. Between 2001 and 2006, the number of passengers flying in and out of Pudong more than quadrupled (JICA 2001; CAAC 2007). Halfway through the Tenth Five-Year Plan, ADP's original scheme for four small terminals and two runways already appeared quaint. Rather than commit to the second phase of the French masterplan, the Shanghai Airport Authority decided to look for other approaches by using two tried and tested techniques: the international design competition and the overseas study tour.

At the height of the Reform and Opening Up era, international design competitions played a key role in the modernization of China's cities and urban infrastructure. They were a relatively quick and cheap way to amass vast amounts of knowledge and ideas from top global thought leaders. Thomas explains:

> The Chinese process . . . is an intelligent way of dealing with airport design. By law they have to bring in a foreign expert into any of these big infrastructure projects. That's weakening now, but when we first arrived you couldn't get anything built without it. So the competition process was the way they brought the ideas of lots of people together. And the Chinese are good at sucking people's minds, and it was a way of picking people's brains. So if you brought in world-renowned experts into the room, and asked them to put their ideas onto the wall, you're buying all their ideas—basically when you give them a fee for competing, you can pick and choose what you like and learn a lot. (J. Thomas 2017)

In 2004 the Shanghai Airport Authority held a competition for a new terminal area masterplan and for a conceptual design for a second terminal. At the midpoint of the competition, the authority sent an overseas delegation to Cincinnati, the headquarters of L&B. Hundreds of airports around the world have been planned out of L&B's Cincinnati home in a suburban office park just off Interstate 71. Li Dirun, the delegation's leader and chairman of the authority, was eager to meet

with Thomas. Although he had failed to win any Chinese competitions, Thomas had established a reputation in mainland aviation circles as an entrepreneurial enfant terrible. Through an interpreter, Thomas and Li discussed alternative arrangements for Pudong's future. Thomas briefed the delegation on L&B's experience in transforming Chicago's O'Hare International Airport, which had undergone a major expansion in the 1980s following the deregulation of the US aviation industry. He argued that the Midwestern behemoth, which served a massive domestic market and functioned as a critical intercontinental gateway, was a more appropriate reference for Shanghai than European hubs like Charles de Gaulle, where domestic traffic was negligible. Moreover, he contended that O'Hare's Midwestern sense of scale—with its generous proportions and ample runways—should be transferred to Pudong to meet the demands of a Chinese aviation market that was growing at breakneck speed. L&B subsequently won the competition. In place of ADP's four smaller terminals, the L&B plan envisioned a "concentrated terminal complex" nearly triple the size of the existing one. Along with a third runway, the new terminal was completed in 2008 (figure 10.5).

Pudong's genesis illuminates the key strategies and processes by which Chinese planners developed aviation infrastructure—and infrastructure more broadly—in the post-Mao era. In particular, an analysis of the Shanghainese hub reveals how Chinese clients deployed three key tools to achieve their development goals: bilateral aid, international design competitions, and overseas study tours. Much like their Hong Kong and Singapore counterparts a generation earlier, mainland infrastructure planners eschewed dependence on a single source of knowledge, talent, or capital, choosing instead to pick the brains of expert engineers, planners, and architects trained in Japan, Western Europe, and the United States. In the 1990s, these three regions represented the most advanced aviation markets in the world. By learning about the evolution of Narita, Charles de Gaulle, and O'Hare from the experts who built them, Pudong's leaders effectively amalgamated the best practices of mature airports, accrued over decades, and used that collective global wisdom to create a twenty-first-century air hub for Shanghai.

Rethinking the China Model

Transportation mega-projects have been analyzed in a variety of academic disciplines through the prism of infrastructure's symbolic value and its use as a political tool. This is not without reason: particularly in developing countries, transportation infrastructure is an easily decipherable index of technical progress and economic development, and of effective stewardship by political elites (Khan 2006). It also operates as a shorthand to explain complex geopolitical relationships, as governments deploy

Figure 10.5. The second phase masterplan for Shanghai Pudong International Airport. (Photograph by Max Hirsh.)

transportation infrastructure both as physical manifestation of bilateral ties and as confirmation of its socioeconomic benefit. As Cole Roskam (2015) has noted, Maoist cadres positioned infrastructure projects as material demonstrations of the PRC's solidarity with developing nations in the Third World, in contrast to the exploitative practices of the capitalist West. Echoes of that infrastructural diplomacy reverberate outward from China in the present day, as the construction of rail and port facilities

manifests intensified economic and diplomatic ties with countries across Africa, Asia, the Middle East, and the former Soviet sphere.

Less apparent, however, is the influx of infrastructural knowledge and design standards into China over the past half-century. While Chinese leaders are eager to promote the export value of a China Model of infrastructure development, they are less forthcoming about the foreign origins (from Europe, North America, and Japan) of that expertise. For better or worse, the China Model represents a globalized, state-of-the-art snapshot of how infrastructure is designed, built, and financed today. However, the China Model cannot accurately be described as a homegrown product, given its hybridization of foreign expertise from multiple sources.

The case of Pudong—like the many Chinese airport projects that followed—sheds light on the relative strengths of each planning culture's design approaches. Through international design competitions and overseas study trips, China's aviation planners cherry-picked what they perceived to be the best attributes of the world's top aviation markets: airfield planning, structural engineering, and long-term infrastructural aid packages in the case of Japan; a no-nonsense approach to terminal design from the United States that emphasizes the demands of a mass domestic flying public; and an aesthetic sensibility from the French that privileges national traditions and abstract formalism.

That division of labor—wherein the French provide the artistic vision, the Americans offer a cost-effective customer experience, and the Japanese deliver the engineering and financing—is undeniably stereotypical. Whether it was brought about by Chinese preconceptions or instead confirms them is up for debate. Either way, that decidedly multilateral approach is how Chinese decision-makers imported the most redeeming qualities of different cultures, and combined them into a China Model of infrastructure development that is adapted to the temporal framework of the five-year plan and to the organizational structure of China's urban planning institutions.

That conclusion leads us inevitably to a rather delicate question: what, then, is uniquely Chinese about the China Model? A review of China's recent aviation history offers a few clues. In contrast to the overseas precedents upon which they are based, airports built in China in the twenty-first century distinguish themselves in three critical areas: speed, scale, and subsidies. If they are able to win the support of the Development and Reform Commission, the mayor, and the local Communist Party secretary, Chinese aviation authorities can execute large-scale infrastructure projects at an unparalleled pace, because they can dispense with consulting and placating local stakeholders. They also face little pressure to demonstrate a credible return on investment, and when a new airport fails to attract

interest from airlines because they do not consider potential routes to be commercially viable, local officials can quickly offer financial incentives—for example, by waiving aeronautical charges (Hié 2017). Chinese cities are hungry for international connectivity, and they are willing to pay for it. At most the world's airports, stakeholder engagement, profitability, and route development are both essential and time-consuming processes. Their absence or relative insignificance in China helps to explain that country's advantage.

China's municipally owned airports likewise distinguish themselves through their scale, thanks to local governments' ability to commandeer vast amounts of land. Over the past decade, airports in China have been progressively reconceptualized as multifunctional "airport economic development zones," some spanning more than a hundred square kilometers (Cao 1999, 133). In effect, local governments no longer build just new airports, but rather entire "airport cities." Chinese infrastructure planners take these temporal and spatial conditions for granted, but they are difficult—perhaps even impossible—to replicate outside China. The lack of attention to critical governance issues, along with the inability to artificially manufacture what is known in the transport industry as throughput, helps us understand why many Belt and Road Initiative infrastructure projects struggled to get off the ground or became mired in the vagaries of local politics.

Conclusion

Let us revisit two questions that I posed at the outset of the chapter. First, how does the production of China's airport infrastructure challenge received notions about the pathways of transnational knowledge exchange? And second, how can this investigation stimulate new conceptual approaches to the study of infrastructure?

First and foremost, more research is needed that links the economic framework of multilateralism to its spatial and material outcomes in the built environment. Infrastructure can serve as an insightful vehicle for investigating how multilateral relations thrive, both in periods that valorize open markets and open borders (as was the case in the late twentieth century, when China reemerged as a global power) and in times marked by resurgent nativism and protectionism (such as the current era).

I have emphasized the previously overlooked role of midlevel experts as agents of transnational exchange. These architects, planners, and engineers collectively design infrastructural systems that enable the movement of goods and people between cities and across continents. Yet they are also crucial actors in the transfer of ideas and information. Modest by nature, they possess a diplomatic acumen

that enables them to collaborate across cultural, linguistic, and ideological divides. Martin Reuss (2008) has pointed to engineers' negotiating skills, rather than their technical proficiency, as the key driver of successful infrastructure projects. That is doubly true for projects in which engineers must reconcile imported norms, standards, and values with indigenous ones. Attempting to strike a balance between "cultural preferences, economic requirements, environmental protection, and various sociopolitical issues at all levels of government," engineers must effectively "mediate the incommensurable."

My study of Chinese airports expands on Reuss's understanding of engineers as negotiators by drawing attention to their role as stealth diplomats and agents of multilateral exchange. Many of my interlocutors first visited China at a time when few foreigners had either the desire or the permission to do so. As we enter a new period of great-power confrontation and isolationism, those same planners and engineers continue to work on Chinese projects, acting as crucial intermediaries at a time when voting publics, and many world leaders, are questioning the benefits of international cooperation.

Most studies focus either on how infrastructure projects meet the aims of governments and economic systems, or on how those projects are received by local constituents on the ground. These two vectors of analysis correspond, respectively, to what Misa (1994) has termed the macro and micro scales of infrastructure's social organization. By contrast, this chapter has focused on what Misa calls the meso scale: institutions whose influence derives from their ability to establish technical standards, and whose impact on infrastructural outcomes is neither as ephemeral as that of micro-level users, nor as enduring as macro-level power structures.

Moving forward, infrastructure scholars would be wise to pay more attention to those meso-scale institutions and the individuals who populate them, for they possess enormous amounts of untapped data that can help us better understand how infrastructure is produced. Attending to that meso scale of influence presents a welcome opportunity to escape the confrontation between top-down and bottom-up modes of inquiry—an unhelpful duality that has divided infrastructure scholars into two competing camps that no longer appear capable of engaging with, or learning from, one another.

Notes

1. This chapter is based on interviews with more than fifty airport directors, planners, architects, and engineers. I would like to thank Daniel Bircher, Elizabeth Bosher, Cai Haiyan, Cai Lingyu, Cao Yunchun, Vivian Cheung, Curt Fentress, Doug Goldberg, Pieter van der Horst, Hsieh

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2. See, for example, Arase 2015; Chan 2018; Godehardt 2014; Kaczmarski 2017; Lim et al. 2016; Miller 2019; Murton and Lord 2020; Oh 2018; Sidaway and Woon 2017; Sternberg, Ahearn, and McConnell 2017; Summers 2016; Yu 2017.

3. These insights are based on five interviews with Dutch and French engineers in The Hague, Paris, and Rotterdam in January 2017 and December 2017. Due to the sensitive nature of the topic, the interviewees have been de-identified.

4. In the nineteenth century, foreign firms seeking to conduct trade in China depended on the services of compradors: middlemen, often hailing from Canton, whose value lay in their ability to bridge the cultural and linguistic barriers that separated outsiders from potential business partners in China. Employing compradors was an effective means for foreigners to quickly overcome their lack of *guanxi*. It was also an effective way for Chinese businesspeople and local officials to gain information about technical and managerial innovations taking place abroad (Abe 2018; Lee 1991).

5. Jing-Jin-Ji refers to a state planning policy enacted in 2014, which seeks to create a socioeconomically integrated mega-region encompassing Beijing, Tianjin, and Hebei Province.

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Afterword

Infrastructural Futures

EDWARD SIMPSON

When I was younger, I attempted to ride a bicycle from Bangkok to Europe. My plan was quickly frustrated by land borders between Thailand and Burma that were closed to me. I learned then that Southeast Asia and South Asia were, in some ways, disconnected. This disconnection was borne of imperial and postcolonial politics. I flew from Bangkok to Calcutta and started to pedal west through the paddy fields and brick-kiln smoke of the Bengal winter. The road was a single strip of tarmac with broad, dusty edges. The surface was rough, potholed, and (to my eyes) unfinished, with the tarmac crumbling into rutted strips of compacted mud. The traffic was wild and unkind, the air dusty and acrid. I clearly recall how many of the roads I took had distinct shapes, cambers, and curvatures. In much of India roads were lined with trees, their trunks painted in regular bands of white and red. Signs, milestones, and paint markings had culture. Junctions had familiar angles, and the superstructure of government accommodations, where cyclists could stay at unfathomably little cost, had an architectural feel and style that spanned across great regions.

A quarter of a century later, I am still followed by the roads I took then. I have learned as an academic how those roads and side spaces got there, and why they took such varied forms over many kilometers in India, Nepal, Pakistan, Iran, and Turkey. I now know that these were not just incidental shapes in the landscape, but that they were given form by history, bureaucracy, and diplomacy. In the 1990s, when I was cycling, infrastructure was most clearly a product of postcolonial institution and nation-building, of technical cooperation between India and a host of competing Cold War friends, and of the now faded efforts made by the United Nations to make new regional alliances in the decades after World War II.

My subsequent research career allowed me to understand how the road in South Asia took on such distinctive shapes: the shapes of colonial rule, Cold War struggle, and the tenacity of road engineers. The single strip of tarmac and compacted mud emerged from decades of trial and error. It was not an accident, or an engineering effort that ran out of money; rather, it had been an important nationalist project. Engineers and scientists had been employed by the nation to test,

experiment, and come up with solutions for a road network in India. They look back on their work as service to and sacrifice for the nation—sentiments not to be taken lightly. The design allowed India to move at different speeds, with trucks and cars occupying the fast-moving center ground, and pedestrians, carts, and bikes on the soft shoulders. Throughout the twentieth century, the idea of a country moving at different speeds was vital for those with an interest in planning and building roads. Now, of course, the road that leaves Kolkata (not Calcutta) is four lanes of fast highway, built to a different set of hybrid standards.

Chapter 8 in this volume, by Till Mostowlansky and Tobias Marschall, describes with great precision and familiarity scenes similar to my own youthful impressions of roads in South and West Asia. Focusing on the chronology of road-building and the relationship between main and lesser routes produces an enchanting palimpsest of meanings and textures beyond those given by the original constructors. Different "projects of modernity," as the authors call them, are fundamentally interconnected and part of a web of routes through which people and institutions interact.

The only map I carried on my bike was a line drawing of West Asia torn from a guidebook (published in the series founded by Tony Wheeler). I navigated with a compass, and although I preferred smaller roads, I repeatedly found myself on the trunk routes that gave the continent a skeleton. Most of these major highways were then still tolerable for a cyclist, but I preferred to be in the wilds—away from trucks, overly strong tea, and the civility of indifference that tends to form among people who remain in places where others are always coming and going.

Some of the main routes, however, seemed impossible to avoid. They drew the traveler back no matter how determined the attempt to escape. Sometimes there were no other roads. More commonly, these roads occupied the easiest paths through difficult landscapes, the paths of least resistance, as people had discovered or worked out many centuries earlier. These were the grand trunk routes of the subcontinent, where people have moved in ways that long predate any modern political or national formulation of territory.

At the time, I knew little of road networks, engineering, or intergovernmental agreements. I do, however, vividly recall rusting signposts pointing to cities many kilometers and several countries away, road numbers that were out of kilter with national numbering systems, and the conspicuously engineered and built-up border crossings between India and Pakistan, Pakistan and Iran, and Iran and Turkey. I later learned that there was an intercontinental vision that had flourished briefly in the 1950s and 1960s in the aftermath of World War II. Interestingly, that project had been quickly taken over by prior geographies: the divisions between Europe and Asia, Iran and South Asia, and South and Southeast Asia.

Utopian road visions designed in an era of reconciliation and reconstruction were unable to defeat older, partly colonial notions of national and regional identity. The terrain mattered; it was not all about the social or imperial construction of space or the artificiality of borders. These roads ended up, despite the best intentions of the so-called diplo-engineers who put them there, as agents of older borders rather than forces of geographical liberation and free movement. National will and international animosity were more powerful than the leveling magic of the road.

The chapters of this book remind me of the map I carried on that cycling trip. They skip across Asia (with a superb detour to West Africa), leaving a spread of graphic images marking the complexity of infrastructural ambition, vanity, and enterprise. They take us into the structuring structures of how things were, are, and might be. These are sharp and arresting accounts that force us beyond numbers and headlines, into the details of particular projects and questions of scale and time. Together, their conclusions collectively bump forward our understanding of how the intentions and consequences of infrastructure come together.

Importantly, together, the chapters bring all manner of infrastructure into the same frame. The result of reading the volume cover to cover is an appreciation of the qualities of infrastructure that make it so fascinating to write and think about. When in and close to it, infrastructure is encompassing. It fills the frame and has an alluring and totalizing logic—both as a political object that can be sold, and as an object of analysis for an academic. But when juxtaposed chapter by chapter, place by place, project by project, infrastructure begins to appear as vulnerable and somewhat random. It loses its seductive logic and all-encompassing rationale.

Scale is put on display in this collection, and the pedestal is supported by some foundational ideas from the literature. First, infrastructures are concrete manifestations of abstract ideas about the world. Second, infrastructures carry with them symbolic power, produce awe, and have uncanny abilities to represent the interests of all manner of political ideologies and aspirations—left, right, state, private, developmental, colonial, and so on. To put it another way, a command economy might build infrastructure to strengthen the nation, and a free-marketeering government might argue that infrastructure facilitates economic growth. Both, in the final analysis, build roads with remarkably similar materials and qualities, which begs an old question: is state ideology an interpretation of the infrastructure imposed on nature, or is infrastructure an interpretation of state ideology?[1]

There is more to it than that, of course, but this simplified diagram is useful because it clears the way for seeing that different forms of political or cultural organization, rather than inhabiting entirely different worlds or ontologies, often have a great deal in common—though that commonality may be disguised by

bluster, boosterism, marketing, the mystification of progress, the division of people into left or right, and the competitive wealth of nations.

I finally found my way to the pleasant task of writing a brief commentary on this book after a year of frantic lockdown teaching online. Among other things, I had read the latest and "hottest" literature on infrastructure and climate change with postgraduate students. We read Bruno Latour (2017a, 2017b, and 2018)—who provides a breathtaking roller-coaster ride through the Anthropocene and into Gaia—all the time haunted by those irritatingly catchy words "We have never been modern," from the title of the treatise (1993) in which he attempted to reconnect the social and natural worlds by arguing that the modernist distinction between nature and culture never existed. In other words, it would be more useful to consider ourselves amodern or non-modern.

Latour has subsequently applied his thought to climate change and, continuing the reconnecting theme, has argued against distinctions between natural and human history (the Anthropocene). More recently, he has seen the potential in the idea of Gaia as a sort of meta-category into which everything can be collapsed and distinguished all at the same time (on this knot, see Latour 2017a). Gaia was initially the idea of the unorthodox scientist James Lovelock, who attributed a force or agency to the earth greater than that of any single element or feature. A lot has been written for and against the concept, which need not detain us (but see Aronowsky 2021 for a subtle yet devastating account). We read a spirited and witty critique of Latour's climate change social science by Andreas Malm (2018), who takes Latour to task for—excuse the brevity—his bourgeois intellectualism. Malm is of the view that it is politically irresponsible to collapse the categories of nature and culture if we are to understand how climate change happened, who is responsible for it, and what solutions might be. We also read of other scholars' disappointment in Latour for not acknowledging the many indigenous cosmologies that they saw as resembling Latour's version of Lovelock's version of Gaia (see, e.g., Whyte 2017).

Then I came to this volume, which abruptly made me ask with new clarity: Who has never been modern? Who is the "we" of Latour's famous title? And, more importantly, what about the rest of the world? What about those who neither inhabit scientific laboratories nor claim an indigenous stake? What about Asia?

Reading Latour suggests new and revolutionary intellectual possibilities. I think it fair to say that the manifesto is not quite there; glimpses of the possibilities tend to be fleeting, rather than permitting a long, hard stare. Sometimes, students felt that they were reading about a new paradigm, a new way of organizing thoughts and possibilities. At other times, we asked: what kind of social science is this? Latour is arguing that we inhabit the world in ways that we do not

properly understand, rather than telling us how other people understand the world. In this volume, there are lots of references to people who are trying to be modern, who embrace wholeheartedly the categories and ambitions that Latour discourages. And while Latour might be inspirational on many fronts, the absence of most of the world from his analysis and the absence of a guide for how to transition from being modern to seeing Gaia are frustrating—not least because his climate project stands a chance only if it engages with Asia. This lack of engagement has implications on a truly planetary scale if, as Mia Bennett argues in chapter 1 in this volume, China has become a geological agent in the Arctic.

Imagine a new subfield with a focus on why academics study what they do. The discipline would sensibly draw on the methods and approaches of history and political economy; on institutional behavior; and on the relationship among politics, publicity, and practice. At the core of the discipline, there would probably be stiff competition to theorize how the world works—quite possibly, given that the stakes are close to home, in a less schematized form than has been routine. The guiding questions of the endeavor might be: Why and how do academics write about some things and not others? And why do some topics become fashionable and gain what we might think of as momentum?

In academia, there might be pockets of exceptional intellectual force that produce something spontaneously original. For the most part, however, scholarship seems, in both structures and practice, to reflect a slightly lagging zeitgeist—a game of catch-up, only gradually apprehending and critically engaging with the consequences of decisions made elsewhere and in times past. This lag is particularly evident in the social sciences, where a chief aim, as I have understood it, is to render with words social realities (however defined). In a practical sense, the planning, questioning, analysis, and writing of research takes time, which places those with faith in empirical evidence behind the curve of the now.

However, my point has less to do with the mechanisms of research and more to do with the ideologies and meta-structures that place ideas in the minds of individual researchers. This emplacement and legitimization of research agendas seems to take time. For example, after climate change was first identified and discussed at global summits, it took four decades for the issue to become a research priority for many institutions. The study of infrastructure seems to have had a similar incubation period, which begs two refining questions: Where might the study of infrastructure come from? What do we anticipate being able to render with words through the study of infrastructure?

There has been a tremendous flourishing of literature on infrastructure in the social sciences. This academic effervescence has already developed a canonical set of citational conventions, with roots in the works of Susan Star (1999) and Geoffrey

Bowker (Bowker and Star 2000), followed by now-ritualized nods to Brian Larkin's (2013) *Annual Review of Anthropology* article. Along the way, some older favorites have been dropped (such as Darian-Smith 1999), perhaps only because the authors' names have not been chanted with sufficient regularity to keep their memories alive.

Infrastructure allows researchers to explore some of the enduring themes of social science: the operation and nature of power, the spread and pursuit of influence, and the ways in which abstract ideas are made into concrete realities. In practice, such studies have generally come to rest at the point of midlevel theory that explores state processes, evolving ideas of governance, dispossession through accumulation, and so forth. The orders and standards of infrastructure are shown to be entangled with the world in multiple ways, their effects rebounding in multiple directions. The general drift of the literature is to start with the surety offered by stereotypes or collective representations, and gradually to unfurl that surety in the winds of ambiguity, rupture, and contingency.

One of the most common effects of this strategy is the demonstration of how infrastructure collides the plan with the contingencies of the world. In the wake of this collision, there are frequently unexpected and unintended consequences. Generally, the plan of infrastructure (broadly conceived of as materials, documents, and political processes) is relatively clear and accessible to researchers. This is, in my view, one of the reasons why infrastructure has become so popular in the social sciences. Infrastructure often comes with a ready-made narrative of what it will do, why it is needed, how its projects will be managed, and what it will look like. There is also often understanding shared among producers, consumers, bystanders, and researchers that readily translates into academic text. Put differently, infrastructure is relatively easy to write about when compared to phenomena such as, for example, freak weather events or the onset of famine.

The just-so narratives of infrastructure can then be compared to the lived worlds of infrastructure builders, scientists, and those living alongside infrastructure to show how the two differ. To paraphrase a well-known anthropological axiom, what they wrote that they do is not the same as what they do. This revelation is such a well-developed strategy in the social sciences that I hope the caricature can be forgiven. In many ways, however, it reminds me of older, open debates in anthropology on the epistemological and methodological relationship between texts and practice in the study of religion. Generally, what was written in religious books turned out not to be the same as what people said was written in religious books, and both were often quite different from what people did on the ground. The pendulum of the debate has swung back and forth between texts and practices to settle most satisfactorily on the ideas that people came first, and that what they

thought—however syncretic, heterodox, or ignorant—is the most productive research focus.

The invention (Hildyard 2016) or reinvention (implied by Bear 2020) of infrastructure as an asset class over the last half of the twentieth century has gradually rippled out from financial institutions and into the world, to governments, consultancies, engineering firms, chartered accountants, and publicists. In South Asia, for instance, publications have emerged on electricity, water, mass transportation, and urban modernization projects, to name a few. On the whole, these publications are live, fresh, and exciting, and set the tone for the study of the region. These various areas have become the focus of specific forms of public and private investment and experiment, and have become associated with particular institutions, modernization programs, and personalities. Researchers have followed the action, so to speak, as International Monetary Fund and World Bank policies (themselves part of a longer history of global elite economics) go on to create new formations, vocabularies, markets, and ways of doing things.

Chapter 10 in this volume, by Max Hirsh, brilliantly illustrates the way the world of consultancy, technical collaboration, and contract allows ideas and conventions to be made real over time. His focus is on the emergence of the China Model and the coproduction of airport architecture and aviation technology on a global scale by Chinese, American, and European interests. He shows how China took certain ideas from these historical interactions and parlayed them into political projects focused on urbanism and development—not least the China Model itself, a sort of mega-brand for all manner of infrastructural development and, of course, part of a political vision for how the world should be organized and by whom.

Elsewhere, interest in infrastructure comes decades after the implementation of structural adjustment policies and the fundamental marketization of South Asian economies. I would suggest therefore that to study infrastructure at the next level (beyond just comparing text with practice) is to focus on a way of making the world anew, rather than infrastructure being the ultimate end. For the development banks, for example, the conditions placed on a loan are the primarily transformative mechanism, rather than the bridge or mass transit system for which the loan is made—just as the China Model aims to bring about a certain form of political and economic dominance in which bridges, roads, and airports are the means rather than the end goal.

In infrastructural terms, despite decades of technological innovation, there is currently no plausible universal alternative to electricity to make televisions light up the lives of billions, nor is there a substitute for water for drinking and irrigation. Mass mobility by air, sea, or land requires the use of energy—usually from

planetary hydrocarbons—to overcome the friction and resistance of the earth (using the earth against itself, so to speak). Infrastructure's broadest strokes remain elemental and rather straightforward: food, water, heat, and movement, in various degrees of elaboration.

To remind you where we have been on our journey in this volume, in chapter 2 Andrew Toland describes a temporal game at play in infrastructural thought—itself, arguably, another infrastructural affect. Infrastructure comes with plans for maintenance and upgrades, as well as with plans for its destruction or phased obsolescence. Step back from the frenzy of construction and now-ism, and infrastructure is never forever: it crumbles and breaks, and, importantly, it is rendered obsolete and outmoded by technocrats, standards, and incumbency. The lesson? Step back.

Part of the nationalist story in Singapore is a determined game of catch-up with the rest of the developed world. Now that Singapore has overtaken much of the rest of the world, its government works to stay ahead of other countries. National entrepreneurship transformed the natural ecology of swamps and seawater into the more valuable ecology of oil. The lesson? Belief in modernity and progress is widespread and carries tremendous popular appeal as a political project.

We also find a leapfrogging metaphor in Gökçe Günel's account in chapter 3 of floating powerships off the coast of Ghana. Temporary power infrastructure enables a vision of transition, linear development, and future progress. Here, the temporal metaphor of progress is twofold: First, temporary power infrastructure comes with the promise of its own obsolescence, enabling a belief in the possibility of leapfrogging to clean energy. Second, powerships bring with them ideas of progress in relationships between Turkey and sub-Saharan Africa. These are the fundamental and related ways of thinking that infrastructure allows: temporality and the narrative of progress. Importantly, these are not the metaphors of the Anthropocene or of Gaia, but of the moderns.

This volume engages with both the social production and the consumption of infrastructure. In these arenas, it is clear that geopolitical plans, the zeitgeist, and innovation engage with each other through infrastructure—interconnectedness, as Anto Mohsin has it in chapter 4. Infrastructure has agency that, once inaugurated or unleashed, will influence ideology, culture, and society.

In chapter 6, Hallam Stevens describes the paternalistic infrastructure of Televiewand its symbolic and practical importance in driving Singapore's economy and maintaining the government's political legitimacy. This infrastructure is designed to assure citizens that their government is taking adequate care of their needs and the nation's future. In cables and screens there is state power, but, importantly, there is also wisdom and beneficence.

In chapter 5, Dorothy Tang argues that the politics of freshwater infrastructure in Hong Kong are rooted in the coproduction of its landscape and water scarcity. Modernity and infrastructure are created by mediating nature across multiple scales and across time and social organizations. One pet project of the moderns is to control nature and manage the environment. These moves necessitate forms of infrastructural intervention that, in turn, produce a distinct experience of modernity, such as the infrastructure spaces in Gui'an described by Tim Oakes (in chapter 7), and in the urban transformation in Ho Chi Minh City described by Jessica Lockrem (in chapter 9).

The deconstruction of the infrastructural mystique is an important political move, not simply to demonstrate the power of the social sciences in a science-dominated world, but also to show what is at stake in an era of climate change that is disguised by the struggles of geopolitics. The words and sentiments used to describe the infrastructure of modernity in this volume have histories rooted in the colonial experience and in the myths of endless growth and national competition. Scholars can demonstrate, largely to themselves, how hollow such ideas are, but that is inadequate. These ideas are the forces that are driving the world, largely through the creation of infrastructure that will have carbon multiplier effects. This is the language of climate change in Asia. When the government minister responsible for roads in India, Nitin Gadkari, stands up (as he often does) and announces his intention to build fifty kilometers of four-lane highway every day from now until 2050, he provincializes the intellectual climate project I have associated with Latour.

The end goal of most infrastructure is remarkably basic, and usually an elaboration of a bodily or social need. However, the obstacles to seeing what is what are extremely complex and multilayered. Seeing through these opens the door onto one of the most pressing questions of the time: how to calibrate resource equality and responsibility in an era of climate change.

I claimed above that infrastructure has qualities and spatial configurations that lend themselves readily to academic description and allow us to plow to a certain depth. Perhaps it is precisely because of such user-friendly qualities that infrastructure is also very hard to unmask: it has characteristics that excuse or absolve it from blame in an era of climate change. Most infrastructure is made to appear both as something necessary and as progress. Infrastructure encodes the logic of development discourse, nation-building, and economic growth, and, as many of the chapters in this volume illustrate, that logic becomes totalizing and exclusive. Thus, there is a need to step back and understand what it means to leapfrog.

Infrastructure excludes the conceptual armature for dealing with questions of climate change. Global construction companies brand their products as resilient,

sustainable, and even green—a genuine case of greenwashing. The emphasis on representation and discourse within the social sciences has forced evaluative and prognostic questions into the wings of analysis. The Anthropocene has become a central concept in the social sciences, appearing in this volume as the "Sinocene" in Bennett's chapter on China as a geological agent. Will the recognition of the Anthropocene save us? There is little doubt that the interplay between human and natural history (Chakrabarty 2009) and the debate about the relationship between parts and wholes (as refracted through Gaia by Latour 2017b, and through debate and reason by Morton 2018) are vital moments of rupture pointing to a paradigm shift within the epistemological politics of the social sciences.

Along the way, this volume asks us to recall political and scalar specificity in identifying and critiquing geological agency. As I have briefly discussed, some scholars have questioned the rights of our scholarly giants to speak the lives of others, and Indigenous voices are well represented in this critical literature. A rather grubbier and more pressing reality is that the conceptual collapse of modernity is a parlor game that can be played in Paris or Chicago, but whose premises look somewhat misplaced by the time you are floating off the shore of Ghana on a ship recycled as an electricity generator or building roads in rural Afghanistan to make the journey to the nearest medical facility less life-threatening.

Note

1. Here I am inspired by Christian Wolmar's (2016) explanation for the lack of transport policy in Britain. Wolmar rhetorically asks, "Are trams socialist?"

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Contributors

Mia M. Bennett is an assistant professor of geography at the University of Washington in Seattle. She researches the geopolitics of infrastructure development in the Arctic through both fieldwork and remote sensing. She is founder and editor of a long-running blog on the Arctic, *Cryopolitics*.

Gökçe Günel is an associate professor of anthropology at Rice University. She is the author of *Spaceship in the Desert: Energy, Climate Change, and Urban Design in Abu Dhabi*, which focuses on the construction of renewable energy and clean technology infrastructures in the United Arab Emirates. Her articles have been published in *Public Culture*, *Anthropological Quarterly*, *Avery Review*, *Engineering Studies*, *Log*, and *PoLAR*.

Max Hirsh is managing director of the Airport City Academy and a research fellow at the University of Hong Kong. A leading global expert on infrastructure and urban development, he is the author of *Airport Urbanism: Infrastructure and Mobility in Asia*. His research has been supported by the Henry Luce Foundation, Fairbank Center for Chinese Studies, and Social Science Research Council. He holds a PhD from Harvard University.

Jessica Lockrem received her PhD in anthropology from Rice University, focusing on public transport planning and motorbike taxis in Ho Chi Minh City, Vietnam. She has published articles in *Mobility in History* and *Science, Technology, & Human Values*.

Tobias Marschall is a photographer and PhD candidate in anthropology at the Graduate Institute Geneva. His dissertation is titled *The Image of Remoteness: Alterity and Mobility in Eastern Afghanistan*.

Anto Mohsin is an assistant professor of science and technology studies in the Liberal Arts Program at Northwestern University in Qatar. He received his PhD

from Cornell University. His teaching and research interests include Southeast Asian studies, environmental studies, energy studies, and disaster studies. His articles have appeared in *Sojourn* and *East Asian Science, Technology and Society*.

Till Mostowlansky is a research professor in the Department of Anthropology and Sociology at the Graduate Institute of International and Development Studies in Geneva. He is the author of *Azan on the Moon: Entangling Modernity along Tajikistan's Pamir Highway*, and has published widely in journals including *History and Anthropology*, *Modern Asian Studies*, *Public Anthropologist*, and *Political Geography*.

Tim Oakes is a professor of geography at the University of Colorado Boulder and is project director for ChinaMade, an international research collective researching Chinese export infrastructure development. His research explores the development and use of leisure and consumption spaces in China. His most recent book is *Making Cultural Cities in Asia*. He has been a visiting professor at the University of Hong Kong, Guizhou Minzu University, the National University of Singapore, Wageningen University, and the University of Technology Sydney.

Edward Simpson is a professor of social anthropology at the SOAS University of London and director of the SOAS South Asia Institute. He was the principal investigator on the European Research Council–funded project Roads and the Politics of Thought, and is the author of *Highways to the End of the World: Roads, Roadmen and Power in South Asia*.

Hallam Stevens is a professor of interdisciplinary studies and Associate Dean (International and Engagement) in the College of Arts, Society and Education at James Cook University in Townsville, Australia. Prior to this, he spent a decade living and working in Singapore as a faculty member at Nanyang Technological University. His research is focused on genomics, the life sciences, big data, and the history of computers.

Dorothy Tang is an assistant professor of architecture at the National University of Singapore. She is also a registered landscape architect in the State of New York, with an interest in the intersections of infrastructure and everyday life. Her work engages with urban and rural communities situated in landscapes confronting large-scale environmental change.

Andrew Toland is a senior lecturer in landscape architecture at the University of Technology Sydney. He holds degrees in architecture, law, and economics. His research examines the use of the Asian megalopolis as a rhetorical device within contemporary architectural theory and practice. He also studies large-scale infrastructure projects in Greater China and the intersections of landscape design and law in the non-human realm.