

Nikhil Anand
Akhil Gupta
& Hannah Appel
EDITORS

THE P R O M I S E

OF INFRASTRUCTURE



THE PROMISE OF INFRASTRUCTURE

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Nikhil Anand, Akhil Gupta, and Hannah Appel, editors

A School for Advanced Research Advanced Seminar

© 2018 Duke University Press. All rights reserved
Printed in the United States of America on acid-free paper ∞
Designed by Courtney Leigh Baker
Typeset in Garamond Premier Pro and Univers by
Westchester Publishing Services

Library of Congress Cataloging-in-Publication Data

Names: Anand, Nikhil, [date] editor. | Gupta, Akhil, [date] editor. |
Appel, Hannah, [date] editor.

Title: The promise of infrastructure / edited by Nikhil Anand,
Akhil Gupta, and Hannah Appel.

Description: Durham : Duke University Press, 2018. | "A School for
Advanced Research Advanced Seminar." | Includes bibliographical
references and index.

Identifiers: LCCN 2017058620 (print)

LCCN 2018000308 (ebook)

ISBN 9781478002031 (ebook)

ISBN 9781478000037 (hardcover : alk. paper)

ISBN 9781478000181 (pbk. : alk. paper)

Subjects: LCSH: Infrastructure (Economics)—Social aspects. |

Infrastructure (Economics)—Political aspects. | Economic

development—Social aspects. | Technological complexity—

Social aspects. | Ethnology. | Technology—Social aspects.

Classification: LCC HC79.c3 (ebook) | LCC HC79.c3 P78 2018 (print) |

DDC 363.6—dc23

LC record available at <https://lcn.loc.gov/2017058620>

Cover art: *Bridge Pile Reinforcement Structure*. Zhengzaishuru/
Shutterstock.com.

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ACKNOWLEDGMENTS

This book began as an Advanced Seminar at the School for Advanced Research (SAR) in Santa Fe, New Mexico. We thank Nicole Taylor, Leslie Shipman, and Michael Brown for tremendous work in creating and maintaining its special scholarly environment. We were encouraged and inspired by the wonderful spirit of collaboration of our seminar participants: Geoffrey Bowker, Dominic Boyer, Catherine Fennell, Penny Harvey, Brian Larkin, Antina von Schnitzler, and Christina Schwenkel. Unfortunately, due to unforeseen circumstances, Catherine Fennell needed to withdraw her contribution from the volume. Nevertheless her insights continue to animate the book. We are also indebted to the participants on two double panels focused on the anthropology of infrastructure at the annual meetings of the American Anthropological Association, first in New Orleans in November, 2010, and subsequently in Chicago in November, 2013. We would like to thank Jessica Barnes, Andrea Ballesterio, Dominic Boyer, Ashley Carse, Brenda Chalfin, Penny Harvey, Brian Larkin, Michael Degani, Curt Gambetta, Elizabeth Povinelli, Janell Rothenberg, Julia Elyachar, Bill Maurer, Suzana Sawyer, Antina von Schnitzler, K. Sivaramakrishnan, and Gisa Weszkalnys for their generous contributions at these sessions. The opportunity to think with Arjun Appadurai, Jessica Barnes, Laura Bear, Ashley Carse, and Austin Zeiderman in these and other fora was especially key in conceptualizing this project. We are grateful for the feedback we received when we presented this work at the Studio for Ethnographic Design workshop at the University of California at San Diego and at the Institute for Advanced Study at the University of Minnesota. Finally, our thanks to Ken Wissoker, Elizabeth Ault, and the editorial team at Duke for their enthusiasm for this project and for their hard work in bringing it out to the world.

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INTRODUCTION

Temporality, Politics, and the Promise of Infrastructure

HANNAH APPEL, NIKHIL ANAND,
AND AKHIL GUPTA

The settlers' town is a strongly built town, all made of stone and steel. It is a brightly lit town; the streets are covered with asphalt, and the garbage cans swallow all the leavings, unseen, unknown and hardly thought about. . . . The town belonging to the colonized people . . . is a world without spaciousness; men live there on top of each other, and their huts are built one on top of the other. The native town is a hungry town, starved of bread, of meat, of shoes, of coal, of light.

—FRANTZ FANON (1961)

In April 2014, the Detroit Water and Sewage Department began to turn off the water of city residents who were behind on their payments. Over the course of the year, tens of thousands of Detroit inhabitants lost access to water in their homes, and fought furiously for its restoration. Also in April 2014, seventy miles north, the city of Flint, Michigan, switched its water source from Lake Huron to the Flint River. Polluted with the effluent from heavy industry and toxic bacteria, chloride and chlorine-based disinfectants that were intended to make the water drinkable only exacerbated the problem. Without additional chemicals to ensure that the first set of chemical additives would not disintegrate pipes, the treated river water corroded the aging plumbing infrastructure made of copper, iron, and lead. Heavy metals leached into municipal drinking water, resulting in widespread lead poisoning that was concentrated in children, as well as an outbreak of Legionnaires' disease.

Both the water cutoffs in Detroit and the new water source in Flint occurred at the order of a state-appointed emergency manager, tasked explicitly with austerity and given the authority to override elected officials. The role of the emergency manager is codified in law under Michigan's "Local Financial Accountability and Choice Act" (Act 436 of 2012: §9(2)). After a section ensuring the ongoing provision of services essential to public health, safety, and welfare,

the Act reads, “The financial and operating plan shall provide for all of the following: . . . The payment in full of the scheduled debt service requirements on all bonds, notes, and municipal securities of the local government, contract obligations in anticipation of which bonds, notes, and municipal securities are issued, and all other uncontested legal obligations” (§11(1)(b)). Debt servicing on infrastructure, in other words, openly superseded democratic governance. Residents of Flint brought bottles of brown water to city hall meetings and documented rashes and hair loss in children, only to be told repeatedly that the water was safe. The local General Motors plant had already stopped using city water in October 2014, citing concerns about corrosion. When the city council finally voted in March 2015 to reconnect to a safe water source, the emergency management team overruled the vote.

Detroit and Flint are predominantly black cities. Here, water infrastructure is a sociomaterial terrain for the reproduction of racism, which Ruth Wilson Gilmore defines as “the state-sanctioned or extralegal production and exploitation of group-differentiated vulnerability to premature death” (2007: 28). The racial necropolitics of Michigan show that infrastructure is a terrain of power and contestation: To whom will resources be distributed and from whom will they be withdrawn? What will be public goods and what will be private commodities, and for whom? Which communities will be provisioned with resources for social and physical reproduction and which will not? Which communities will have to fight for the infrastructures necessary for physical and social reproduction? In Detroit and Flint, the centrality of municipal debt, the privatization of public goods and services, and market-led governance might lead us to view both as typical examples of neoliberalism in practice. But in both cities, the water shutoffs were as much a result of longer struggles that date back to the 1930s as they were of more immediate pressures emanating from Wall Street (Cramer and Katsarova 2015). For example, one can trace differences in transport and utility infrastructures to the Federal Housing Authority’s redlined maps that ensured racial segregation occurred within city limits (Highsmith 2015; Ranganathan 2016). The state-sanctioned infrastructural abandonment that ensued over the following decades is coded today as the product of financially irresponsible residents on whom austerity and dispossession can justly be visited. Indeed, part of Detroit’s bankruptcy agreement was the quiet transfer of control of the municipal water infrastructure—serving a largely African American population and governed by their elected leaders—to a regional water board serving Detroit’s suburbs. After five decades of deindustrialization and outmigration from the city, the water-board members were still 80 percent white.

Infrastructures around the world—from the United States to Fanon's Algeria to Palestine—offer archaeologies of differential provisioning that predate neo-liberalism. Palestine, as Stephen Graham (2002), Eyal Weizman (2012), and others have shown, is a zone of infrastructural warfare, where water tanks, electricity transformers, roads, electronic communications, radio transmitters, and airport runways are often targets. And as the quote from Fanon with which we open this introduction suggests, the experience of infrastructure has long been an affective and embodied distinction between the settlers' town and the town belonging to the colonized people (see also Mrázek 2002; Barak 2013).

We start a volume on the promise of infrastructure here—in the United States, in Palestine, in colonial Algeria—to show the multivalent political trajectories of both infrastructure and the idea of promise. Material infrastructures, including roads and water pipes, electricity lines and ports, oil pipelines and sewage systems, are dense social, material, aesthetic, and political formations that are critical both to differentiated experiences of everyday life and to expectations of the future. They have long promised modernity, development, progress, and freedom to people all over the world. As deep-water rigs drill for oil in West Africa, as roads in Peru or Bangalore promise new connections, or as emerging economies rapidly build dams to modernize their agriculture, infrastructures are critical locations through which sociality, governance and politics, accumulation and dispossession, and institutions and aspirations are formed, reformed, and performed. At the same time as they promise circulation and distribution, however, these precarious assemblies also threaten to break down and fail. From the Deepwater Horizon conflagration to the Fukushima Daiichi nuclear-power plant, from the collapse of school buildings in China to the destruction in the wake of Hurricanes Katrina and Sandy, to the failure of the derivatives market in the 2008 financial crisis, infrastructural breakdown saturates a particular politics of the present. On the one hand, governments and corporations point to infrastructural investment as a source of jobs, market access, capital accumulation, and public provision and safety. On the other hand, communities worldwide face ongoing problems of service delivery, ruination, and abandonment, and they use infrastructure as a site both to make and contest political claims. As the black cities of Michigan or the rubble in Palestine forcefully show, the material and political lives of infrastructure frequently undermine narratives of technological progress, liberal equality, and economic growth, revealing fragile and often violent relations between people, things, and the institutions that govern or provision them. This tension—between aspiration and failure, provision and abjection, and technical progress and its underbelly—makes infrastructure a productive location to examine the

constitution, maintenance, and reproduction of political and economic life. What do infrastructures promise? What do infrastructures do? And what does attention to their lives—their construction, use, maintenance, and breakdown; their poetics, aesthetics, and form—reveal?

In recent years, cultural anthropologists have asked these questions of infrastructure. As a result, infrastructure is no longer invoked only as a conceptual tool, as, for instance, in Louis Althusser's (1969) famous invocation of infrastructure in theorizing capitalism, but as itself the object of ethnographic engagement (see Larkin 2013 for a helpful overview). This volume shows how oil rigs and electrical wires, roads and water pipes, bridges and payment systems articulate social relations to make a variety of social, institutional, and material things (im)possible. These "hard" infrastructures are classically anthropological subjects, because attention to them is also attention to sociality, to the ways infrastructure "attracts people, draws them in, coalesces and expends their capacities. . . . People work on things to work on each other, as these things work on them" (Simone 2012).

Infrastructure, like the state in an earlier theoretical moment, has often lurked in the background of anthropological research. Why the surge in contemporary interest? As Antina von Schnitzler asks, "Why infrastructure, why now, and to what end" (von Schnitzler 2015; see also Boyer, this volume)? To answer this question, von Schnitzler attends to the ways in which apartheid was enacted in South Africa through the differential management of infrastructure. Ethnographic attention to infrastructure reveals how politics not only is formed and constrained by juridico-political practices, but also takes shape in a technopolitical terrain consisting of pipes, energy grids, and toilets. An attention to infrastructure, von Schnitzler argues, is classically anthropological because it provides a frame to defamiliarize and rethink the political. Yet to recognize why infrastructure has emerged anew as an analytic and ethnographic object at this moment, we also need to attend to infrastructure's performance as a technology of liberal rule.

In his book *The Rule of Freedom* (2003), the historian Patrick Joyce demonstrates how the construction and management of infrastructure emerged as a key technology of government that was central to the performance of liberalism (see also Mitchell 2011). While privileging the circulation of people and things, infrastructures also served to permit states to separate politics from nature, the technical from the political, and the human from the nonhuman. Thus depoliticized, the management of infrastructures as a technical problem formed the grounds on which subjects were "freed" to participate in civil society and produce economic life. Infrastructures gave form to relations between

states and subjects on one hand, and corporations and capitalist circuits on the other. Infrastructures have continued to be central to the work of government since the nineteenth century, and as these opening references to the infrastructures of colonial Algeria, the contemporary United States, and Palestine demonstrate, this form of governance known as liberalism must always be understood, from its inception, as guaranteeing the liberties of some through the subordination, colonization, and racialization of others (Singh 2005; Melamed 2006; Sheth 2009; Mills 2011). Infrastructures have been technologies that modern states use not only to demonstrate development, progress, and modernity, giving these categories their aesthetics, form, and substance (Larkin, this volume), but also to differentiate populations and subject some to premature death (Fanon 1961; Gilmore 2007; McKittrick 2011).

As liberal modernity has (partly) shifted to neoliberal postmodernity, proponents of neoliberalism have argued that particular kinds of infrastructures are necessary to capitalism, and, as such, need to be continually produced (by states, corporations, or different combinations of these) to ensure the reliability of capital and labor flows. Today, as nation-states, particularly in the global South, seek to change their terms of integration into the global economy, they have undertaken dramatic infrastructure projects in varied financial and engineering relationships with private firms. Largely due to foreign investment in its infrastructure, the small central African country of Equatorial Guinea had the highest ratio of investment to gross domestic product of any national economy in the world in 2013 (Harrison 2013). In India, China, and elsewhere, governments see the construction of roads and telecommunication systems as being essential for the production of goods and services for markets as distant as North America and sub-Saharan Africa. The rapid construction of infrastructures in these nation-states is, in turn, shifting the geography of infrastructure expertise. Chinese and Indian companies can be found throughout continental Africa and South America, exporting labor, capital, and inputs like steel to build infrastructures far beyond their national borders.

The uneven flurry of infrastructural investment in the global South coexists with its mirror image in the United States and the United Kingdom, where neoliberal austerity regimes have withdrawn public funds for building and maintaining infrastructure. Such regimes subsist by wearing down the Keynesian investment in the roads, railways, water lines, sewage systems, and telecommunication systems of an earlier historical moment. In the absence of maintenance work on one hand, and neoliberal refigurations of infrastructure grids on the other, existing infrastructures have deteriorated to such an extent that they are breaking down more often (Bennett 2010). This moment has made

infrastructure visible in the global North in different ways. As Dominic Boyer argues in this volume,

The Keynesianism that preceded neoliberalism, dominating western political economic theory and policy from roughly the mid-1930s until the mid-1970s, often utilized large-scale public works projects as key instruments for managing labor, “aggregate demand,” and the affective ties of citizenship. Thirty years of privatization, financialization, and globalization later, this legacy of “public infrastructure” has become rather threadbare, capturing a general sense of evaporating futurity in the medium of corroded pipes and broken concrete. Of course, neoliberalism did promote aggressive investment and innovation in infrastructural systems necessary for the advance of financialization and globalization (not least telecommunications, the Internet, and transportation). At the same time, infrastructural temporalities look rather different from the perspective of the global South where . . . ruination is a constant companion of infrastructure. But across the global North, one cannot be faulted for feeling a creeping sense of decay spreading across many infrastructural environments. Thus, the turn to infrastructure could be viewed as something like a conceptual New Deal for the human sciences—a return of the repressed concerns of public developmentalism to an academic environment that has, like much of the rest of the world, become saturated with market-centered messages and logics over the past three decades.

Boyer encourages us to look beyond this nostalgia for petro-fueled Keynesianism, to see the infrastructural turn instead as part of the wider anti-anthropocentric turn in the human sciences. He takes the turn to infrastructure as a sign “that we are conceptually re-arming ourselves for the struggle against the Anthropocene and the modernity that made it,” a provocation that we return to later in this introduction.

Within and beyond the histories of (neo)liberalism we describe, infrastructure is an integral and intimate part of daily social life: it affects where and how we go to the bathroom; when we have access to electricity or the Internet; where we can travel, how long it takes, and how much it costs to get there; and how our production and consumption are provisioned with fuel, raw materials, and transport. It is important to underline what may seem self-evident: infrastructures shape the rhythms and striations of social life. Class, gender, race, and kinship are all refracted through differentiated access to infrastructure, deciding whether water or electricity is available and to whom (Ferguson 2012). Who, in a given family or community, carries water from the stream or from a

communal tap into the home? Which families can afford a rooftop diesel generator? Cellular networks also reshape gendered socialities: daughters-in-law in Delhi may be allowed to leave the home but their movements are monitored by calls every few minutes; FaceTime and WhatsApp change forms of familial connection and communication at a distance. But even these insights provoke more questions than answers. Take electricity, for example: apart from the fact that people make illegal connections, we know very little of how electricity is actually used within homes. For what do people use electricity? What uses do they consider essential (Degani 2013; Kale 2014)? How is electricity integrated into people's daily lives, from homework for the kids to entertainment and leisure activities (TV, radio, computer, Internet, etc.)? Even as utilities and governments perceive a growing need to handle shortages and to imagine energy transitions, they know very little about daily use, daily need, and what might be socially possible. The promise of infrastructure, then, is multivalent. This volume indexes not only radical disconnection and abandonment, but also aspiration, the prospective, and futurity, of both infrastructures themselves and our work with them. We present a set of scholars working on infrastructure today, but we also gesture to all the work still to be done.

Of course, any given future is built on a past. The relationship between infrastructure, environment, and modernity has preoccupied anthropology since the beginning of the discipline. Cultural materialists like Leslie White (1943), Marvin Harris (1966), Julian Steward (1955), and even Marcel Mauss (2008) were critical of modernization stories of lag and lack, often told through gestures to the technological sophistication of what were believed to be discrete cultures. These theorists paid close attention to the ways in which irrigation, energy, and other technical systems mediated relations among local environments and labor and cultural practices. In his famous consideration of wet and dry irrigation technologies, for instance, Clifford Geertz (1972) drew attention to the ways in which these produced different kinds of persons and political authorities. Engaged with the work of Geertz, Stephen Lansing (1991) attended more closely to the "engineered landscapes" of irrigation in Bali, demonstrating how these infrastructure regimes transform and humanize nature, generating durable political institutions.

Newer work has further developed this engagement by attending to the ways in which environments and landscapes have to be remade so that infrastructures may behave according to human designs. Such projects to manage and order landscapes are always provisional achievements, dependent on the reliable performances of people and environments that are not always under the control of engineers and planners (Ballesterio 2015). For instance, Ashley

Carse (2014) demonstrates how distant watersheds in upland Panamanian forests need to be continually made and extended as, in effect, the infrastructure of infrastructure, so that these deliver reliable quantities of water for the Panama Canal. As the materiality of the earth, the reliability of rain, and the political claims on the watershed are variable, the efficacy of the canal depends on the degree to which engineers, hydrologists, and politicians can consistently mobilize the water that it needs to work. Yet, to what degree might we expect nature to continue serving as infrastructure's infrastructure (Jensen 2017)? As humans intervene in the climatic, geological, and evolutionary processes of the Anthropocene (Chakrabarty 2009), both the effects and futures of modern infrastructuring projects appear increasingly tenuous.

This volume is indebted to earlier approaches in the field, not just in anthropology, but also in urban geography and STS. Thus, before turning to the three interventions of the volume (on time, politics, and promise), we schematically lay out an array of genealogies on which this volume builds: (1) critical Marxist perspectives from Althusser to Walter Benjamin, and the development studies literature they have influenced; (2) the government of difference in cities; and (3) the STS literature that attends to the practice of design and engineering. Part of the intervention of this volume, and the emergent anthropology of infrastructure of which it is a part, is to ask how these genealogies can be repurposed to new ethnographic, political, and theoretical ends.

Marxism, Development, and the Telos of Infrastructure

Seeking to account for the social and political changes brought about by the industrial revolution, Marxist and liberal theorists alike often deployed metaphors of infrastructure and technology to make their cases. Take, for instance, Marxist references to infrastructure in theorizing capitalism. In a famous passage, Althusser writes, "Marx conceived the structure of every society as constituted by 'levels' or 'instances' articulated by a specific determination: the infrastructure, or economic base (the 'unity' of the productive forces and the relations of production) and the superstructure, which itself contains two 'levels' or 'instances': the politico-legal (law and the State) and ideology (the different ideologies, religious, ethical, legal, political, etc.)" (1961: 134.). Althusser specifies that his invocation of infrastructure is a metaphor: "Like every metaphor, this metaphor suggests something, makes something visible. What? Precisely this: that the upper floors could not 'stay up' (in the air) alone, if they did not rest precisely on their base. Thus the object of the metaphor of the edifice is to represent above all the 'determination in the last instance' by the economic

base” (135). Althusser’s famous metaphor of the edifice draws on the meaning of the prefix “infra” (below, beneath, or within) to make an argument about relative autonomy, reciprocal action, and determination in the last instance between infra- and superstructure.

Searching early writing in social thought for more literal accounts of infrastructure as a material form as opposed to a heuristic device, we note that infrastructure often appears as a temporal marker in the techno-developmental teleologies (Engels [1884] 2010) that not only animated Marxist approaches to capitalism and theories of economic modernization (Rostow 1960), but also played a similar role in early anthropological theory. For instance, in his attempt to place different cultures in a larger common humanity, Lewis Henry Morgan ([1877] 2004) saw technological development as the force behind cultural development, suggesting that changes in social institutions, organizations, and ideologies emanated from advances in technology. A culture’s “arrival” at each progressive stage was marked by a signature technological achievement: fire, bow and arrow, irrigated agriculture, iron manufacture, and so on. Infrastructures and technologies here are both material and symbolic, standing in for a culture (or an economy’s) development along a linear temporal scale. Within these now-dismissed theories of teleological progression, we can find the seeds of analytic insight. Take Benjamin’s “Iron Construction F” from the Arcades Project. Even as he partakes in developmentalist ideas about the stage of civilization marked by iron, Benjamin also draws our attention to the indivisibility of the “politics and poetics” of infrastructure (Larkin 2013) and to the ways that materials are always “in the grip of dreams” (152) and come with “the peculiar and unmistakable dream world that attaches to them” (156). The tensile properties of iron permit it to be drawn into fantastic material formations: high-rises, arcades, and bridges; formations that celebrate a release from the earth and its histories, gesturing instead to a time and space oriented to the future.

In the late twentieth century, materialist approaches to development withered under poststructural critique, particularly in anthropology (Marcus and Fisher 1986; Gupta and Ferguson 1992). Anthropologists drew on the work of Michel Foucault to argue that material reality does not exist independently of or prior to representational practices. Discourses, narratives, and language give form to infrastructure as much as concrete, wires, or zoning regulations (Ferguson 1994; Escobar 1995). Anthropologists also drew attention to the multiple histories, geographies, and temporalities in relation to which states, infrastructures, and their developmentalist projects were situated (Gupta 1998; Nugent 2004). Nations and national development, as such, did not exist in empty,

linear time that was quantifiable by the state of the economy or its enabling technological milieu (Anderson 1983; Gupta 1998). Instead, politics are situated heterochronically, partly formed but not determined by infrastructures and governmental technologies they seek to proliferate (Chatterjee 2004).

Cities and the Government of Difference

While infrastructure itself has not always been a central analytic in the social sciences, systems and norms of distribution have long interested archaeologists, historians, anthropologists, and geographers. Distribution, of course, points indirectly to the ways in which infrastructures—roads, energy networks, and water systems—redistribute resources, form politics, and have political effects. Scholars of irrigation infrastructures, like dams and canals, for instance, have demonstrated how these works, while being constructed, displace millions of residents in order to redistribute resources to a relatively more powerful few (Kothari and Bhartari 1984). This approach has been especially well developed in urban geography, where scholars have built on Marxist approaches to the built environment, focusing on the production and differentiation of space, often in direct relation to capital. Infrastructure development, Colin McFarlane and Jonathan Rutherford (2008) point out, is fundamentally a political process. Infrastructure, like science, is “politics pursued by other means” (Latour 2012: 38). Stephen Graham and Simon Marvin (2001) take a Lefebvrian (1991) approach to urban space and infrastructure. In *Splintering Urbanism* (2001), they question the singularity, ubiquity, and taken-for-granted forms of infrastructures, urging us instead to attend to them as dynamic and congealed processes of organizing finance, knowledge, and power:

A critical focus on networked infrastructure—transportation, telecommunications, energy, water, and streets—offers up a powerful and dynamic way of seeing contemporary cities and urban regions. . . . When our analytical focus centers on how the wires, ducts, tunnels, conduits, streets, highways and technical networks that interlace and infuse cities are constructed and used, modern urbanism emerges as an extraordinarily complex and dynamic socio-technical process. . . . As capital that is literally “sunk” and embedded within and between the fabric of cities, [urban infrastructures] represent long-term accumulations of finance, technology, know-how, and organizational and geopolitical power. (Graham and Marvin 2001: 8)

For Graham and Marvin, infrastructure is an assembly of sociotechnics, and cities are made through assemblies of infrastructure. But rather than thinking of distanced or aloof hardware networks, they invoke Raymond Williams's (1973) "structures of feeling" to note that infrastructures also give shape to and are shaped by quotidian human experiences and sentiments of hope, inclusion, violence, and abandonment.

To paraphrase Susan Leigh Star (1999), to study a city and neglect its sewers and power supplies, you miss not only essential aspects of distributional justice and planning power, but also dreams and aspirations, breakdowns and suspensions, and the intimate rhythms of how we wash or go to the bathroom, how we see in the dark or cool our food, and how we travel across space (379). If urban geographers have drawn attention to the material forms of infrastructure, and the ways in which they differentiate and structure urban life, anthropologists have attended more closely to the lived experience of unequal provisioning and differentiated belonging in cities (Caldeira 2000; Chu 2014; Schwenkel 2015a). City residents often push back against this differentiated belonging, making claims to social membership, political belonging, and rights to modernity in terms of infrastructure, whether imaginary, potential, or derelict (von Schnitzler 2013). Conversely, groups may identify everyday relationships with infrastructure marked by interruption, improvisation, and modification as a metonym of their marginality (Ferguson 1999; P. Harvey 2010; Anand 2017).

Consider a road infrastructure. Communities that are not connected to the nation-state by roads often see themselves as marginalized by its absence (Harvey, this volume). Inasmuch as roads are associated with development, improvement, and modernity, roads are sites of representation and aspiration (Coronil 1997; Larkin 2008). Yet while roads are desired by political subjects, they are not always used in the ways that state planners intend (Mrázek 2002). Before long, their designs are repurposed, altered, and populated by the heterogeneous dreams, desires, and practices that confound the goals and intentions of their designers (Scott 1998; de Certeau 2002; Mrázek 2002).

Critically, while anthropologists have been especially attentive to the heterodox lives formed by infrastructure in cities, they have also drawn attention to the flexible, provisional ways in which social networks step in when material infrastructures fail to deliver (Simone 2004; Elyachar 2010). Water pipes, electricity grids, and roads are always breaking down, need constant maintenance, and are regularly being claimed by groups authorized and unauthorized by city government. Moreover, marginalized others constantly make claims on and form infrastructures beyond those controlled by the state. In these ways, infrastructures are fundamentally social assemblies (Schwenkel, this volume). In

insisting we see “people as infrastructure,” AbdouMalik Simone (2004) draws attention to the ways in which social relations are a central, hidden, and vital support system necessary to live in cities. In what appears to some as the ruins of inner-city Johannesburg, a “highly urbanized social infrastructure” (Simone 2004: 407) enables people to improvise socioeconomic links with one another, providing what failed public services or formal-sector employment has not. To quote Simone, “Infrastructure is commonly understood in physical terms, as reticulated systems of highways, pipes, wires, or cables. . . . By contrast, I wish to extend the notion of infrastructure directly to people’s activities in the city” (407). Elsewhere, Simone (2012) points out that the reticulated systems (on which this volume focuses) are themselves loci of people’s activities, and they cannot be so easily dismissed as “merely” physical. As city employees and residents alike invest labor and care into everyday practices of maintenance and repair, they make more-than-human assemblies of infrastructure that are generative of differentiated materializations of rights, resources, and aspirations in the city.

Science and Technology Studies: Engineering Politics

Historians and sociologists of technology have been at the forefront of a larger turn toward infrastructure in the social sciences. In their influential work, Susan Leigh Star and Karen Ruhleder insist that “infrastructure appears only as a relational property not as a thing stripped of use” (1996: 113). Rather than being a singular thing, infrastructure is instead an articulation of materialities with institutional actors, legal regimes, policies, and knowledge practices that is constantly in formation across space and time (Ribeiro 1994; Mitchell 2002; Edwards 2003). Accordingly, infrastructures are seldom built by system builders from scratch. They are instead brought into being through compromised, improved projects of maintenance and repair (Mitchell 2002; Graham and Thrift 2007; Jackson 2014). They have histories and “grow” incrementally in a dynamic temporal, spatial, and political environment (Edwards et al. 2009: 369). They are formed with the moralities and materials of the time and political moment in which they are situated (Hughes 1983). Equatorial Guinea’s national highway system and rapidly constructed gleaming buildings, for example, are very much of and in the time of oil extraction; they were built to announce the spectacular, if temporary, wealth of the petro-state to domestic residents and international visitors alike (Coronil 1997; Apter 2005; Limbert 2010; Appel 2012a, 2012b).

Emerging from the recognition that infrastructures grow temporally and incrementally, STS scholars have been particularly attentive to the emergent nature of expertise of those who manage, maintain, and extend infrastructures. Rather than assume that experts (corporate engineers, state officials, plumbers) possess an already formed expertise that they deploy to act and repair infrastructural problems, scholars have demonstrated how expertise and authority emerge from improvised, compromised heterogeneous practices that are performed amid partial knowledges and intransigent materialities (Law 1987; Bowker 1994; Harvey and Knox 2015). Infrastructures have no heroes or obvious system builders sitting in air-conditioned offices who bring them into being from a distance (Furlong 2014). Experts, often at their own admission, only have a partial knowledge of their working and are constantly compromised by the materialities and contingencies of infrastructure projects (Bowker 1994; Harvey and Knox 2015). Engineering expertise is made in the field, through efforts to repair and make infrastructures work again.

As such, sociologists of technology have attended to the labor of managing and maintaining infrastructure. Just as anthropologists might better apprehend the workings of the state by attending to the practices of lower-level governmental officials (Gupta 1998; Sharma 2008), Susan Leigh Star has urged scholars to focus on the very ordinary infrastructure workers, such as janitors and cleaners, who are otherwise unnoticed in everyday life (Star 1999: 386). These workers are vital to the everyday distributions and social life of infrastructure. Anthropologists have begun to follow Star's provocation. An attention to the practices of low- and mid-level administrators and technicians challenges any easy characterizations of technopolitics as exercised from afar (Anand 2017). Finally, STS scholars have also urged scholars of infrastructure to pay more attention to "those at the 'receiving' end of infrastructure"—those who are subjected to its distribution regimes and marginalizations in everyday life (Edwards et al. 2009: 371). As Edwards et al. ask, "How can claims on, through, and against infrastructure be formulated, organized, and heard? What constitutes adequate representation or participation in the process of infrastructural change and development? Under what conditions can rival interests in infrastructure (large and small, modest and profound) be acknowledged, addressed, and accommodated, in ways that enhance the legitimacy, appropriateness, and long-term efficacy of infrastructural change?" (Edwards et al. 2009: 372).

Anthropologists are well positioned to answer these questions through ethnographic studies of infrastructure. An attention to the materialities and socialities that are gathered to form infrastructures promise to both demonstrate

how these vital support systems are formed, and also how they bring other things into being and constitute social worlds (Ferguson 2012: 559).

In this volume, we draw together insights from STS, urban studies, and development studies to ask critical questions about how anthropologists study infrastructure. What happens when infrastructure is no longer a metaphor? What happens to theory making and ethnographic practice when roads, water pipes, bridges, and fiber-optic cables themselves are our objects of engagement? How do we take seriously the developmentalist fantasies and desires for modern infrastructure, often articulated by marginalized subjects themselves (Ferguson 1999)? A focus on infrastructure enables us to consider seriously the articulation (and disruption) between the technologies of politics and the politics of technology (Barry 2001; Anand 2011). By shifting our attention to infrastructures as ethnographic objects we promise new theoretical and political insight both for anthropology and from anthropology. Like Chakrabarty's (2000) provocation to "provincialise Europe," attention to infrastructure forces us to ask: What do we see differently and understand otherwise when we shift the analytic center? We see studies of infrastructure as a forceful reengagement with gender, race, colonialism, postcoloniality, and class on new empirical and political terrain. Infrastructure provides a site in which these forms of power and inequality are reproduced or destabilized, in which they are given form, occasionally obduracy, and often contingency. Precisely because all knowledge is situated (Haraway 1991), where we think from and what we think about affects what it is that we are able to think. Thinking from and with infrastructure allows new and productive decenterings and provincializations: space-time compression, for instance, depends on contested material and aesthetic choices; and liberal governance is no longer rationality at a distance, but politically intimate practices. And indeed these are the themes—time, politics, and promise—around which we organize the volume and the remainder of the introduction.

Time and Temporality

Brian Larkin (2013) begins his influential essay on infrastructure by observing that "infrastructures are built networks that facilitate the flow of goods, people, or ideas and allow for their exchange over space" (328). Space and spatiality naturally come to mind when thinking of infrastructure's features and effects. Infrastructures bridge distance; roads, railways, wires, and pipes help connect one point to another, and they are heavily dependent on and constitutive of local geographic contexts (Hughes 1983; Coutard et al. 2004).

Whether one thinks of channels of transport like railway lines or flight paths, of electric and communication wires, or the movement of resources like water or oil in pipelines, it is the connection through space that is central to the working of infrastructure. As Larkin observes, “For some time now, scholars in science and technology studies and geography have analyzed how infrastructures mediate exchange over distance, bringing different people, objects, and spaces into interaction and forming the base on which to operate modern economic and social systems” (2013: 330). But infrastructure, of course, mediates time as much as it mediates space (Degani 2013; Hetherington 2014). Infrastructures configure time, enable certain kinds of social time while disabling others, and make some temporalities possible while foreclosing alternatives (Barak 2013).

Revisiting two ideas that have become commonplace in the present—time-space compression and just-in-time production—demonstrates the imbrication of time with infrastructure with particular clarity. First, the notion of space-time compression, popularized by David Harvey in *The Condition of Postmodernity* (1989), referred in part to the ability to conduct “real-time” financial transactions across the globe. Second, just-in-time production referred to supply-chain changes enabled by global shipping, containerization, and the global factory floor, all of which sharply cut the capital tied up in products sitting in warehouses by more closely aligning supply with demand, thus significantly reducing the chances of a crisis of realization (D. Harvey 1989). What were the infrastructural conditions that facilitated the move toward real-time transactions? Much of this story hinges on an effort to lay undersea fiber-optic cables that connected global financial centers. As Nicole Starosielski’s (2015) work demonstrates, this messy project is deeply entangled with daily life in Guam, undersea aquatic life, and both colonial and cold war telegraph and telephone infrastructures. Just-in-time production too depended on the installation of communications infrastructure, as well as new technologies for inventory control and management, not to mention containerization and global shipping (Carse 2014). These infrastructures of contemporary capitalism were developed over long periods of time, in a process that was neither linearly progressive nor uniform (Rosenberg 1976; Elster 1983). Thus, time-space compression is itself a temporal process that comes into being with the simultaneous development of new technologies of communication (fax machines, fiber-optic cables), a massive investment of capital and labor to connect vast distances with these technologies, and new methods of managing inventories and logistics (Sassen 1991; Starosielski 2015). Once installed, these infrastructures introduced new (and always more fitful than portrayed) temporalities in the

worlds of finance, commodities, and labor, which in turn changed the nature and experience of social time and social space.

In *Knowing Capitalism* (2005), Nigel Thrift writes that “it is all too easy to depict capitalism as a kind of big dipper, all thrills and spills. But capitalism can be performative only because of the many means of producing stable repetition which are now available to it and constitute its routine base” (3; see also Gupta 1992). Infrastructure, of course, is chief among these means of producing the more or less stable performance of both real-time transactions and just-in-time production. While Thrift does not use the term infrastructure specifically, he seems to be urging our attention to it—toward what he calls “the apparatus of installation, maintenance, and repair” on the one hand, and “the apparatus of order and delivery” on the other.” Thrift writes, “For some reason, perhaps to do with their extreme everydayness, these apparatuses are constantly ignored in the literature, and yet it could be argued that they constitute the bedrock of modern capitalism” (2005: 3).

Thinking of time-space compression and just-in-time production through infrastructure paradoxically draws attention to the slowness of the process of speeding up. For example, it draws our attention to the resistance present in telegraph or fiber-optic cables—the difficulties involved in financing them, and then in installing and repairing them (Barak 2009; Starosielski 2015). Rigorous attention to infrastructure itself actually slows time-space compression enough to see delay, accretion, suspension, repair, resistance, and repurposing. Ethnographic attention to infrastructure may “ultimately undermine any idea that speed or time economy—the grossest simplification of efficiency’s logics—is at the heart of capitalism. Instead, we will be able to explore the heterogeneous forms of pacing, duration, waiting, pause, obsolescence, and delay that also characterize its generative rhythms” (Bear et al. 2015: sec. 8; see also Bear 2015).

The larger point here is not to displace thinking about space by the logic of time, nor to privilege time over space. Focusing on time and temporality, in fact, helps us think of spatiality in new and interesting ways; it allows for a rethinking of spatialization as itself a temporal act and activity (Althusser 1969; D. Harvey 2005; Gidwani 2008). Temporality is built into spatial expansion, contraction, and scaling. Attention to the life span of infrastructure itself slows us in this way, hence attuning us to the shifting social temporalities that infrastructure produces. For example, a new metro system is rarely put into place all at once (Latour 1996). Instead, one main line is first prepared and started, which changes the time that it takes for people to commute from their homes to workplaces, or from one part of the city to another. It also changes the urban form, as new housing, offices, and shops spring up along the metro line. Real

estate markets shift as valuations of property that might have formerly been thought undesirable go up because they now are adjacent to the metro line. Then, as new lines are added to the metro, further shifts take place in commute times and in the urban form. The temporality of infrastructure, therefore, matters a great deal in the creation of spatial patterns of living, working, and entertainment; it influences the direction and degree of spatial extension; and it has profound social and political impacts. Like metros and rail lines, highways, cable networks, and even wireless communication all extend spatially over time, and it is this temporality that in turn produces variegated forms of spatiality and particular patterns of sociality.

A perfect example of the temporal interplay between spatial and social extension is provided by Antina von Schnitzler's work on metered water and electricity in South Africa. In response to the supply of expensive water and electricity in the townships of South Africa, residents found a way to tamper with the meter so that they did not have to pay high bills. In response, utilities began providing connections through a new tamper-proof technology of prepaid meters. In this case, the spatial extension of piped water and electricity encountered political resistance, but precisely because the spatial extension unfolded over time, that resistance was itself enfolded in a new technology of governmentality. The spatial, the temporal, and the political were mutually produced in this encounter. Or consider Nikhil Anand's work on water politics in Mumbai: the spatial extension of pipes that can potentially supply non-authorized settlements with municipal water depends on a politico-temporal trajectory, one in which elaborate negotiations occur over an extended period of time among slum residents, politicians, and engineers and managers in the hydraulic bureaucracy. The outcome of such negotiations is always uncertain and subject to revision. Thus, the relationship between having pipes and having water is always up for grabs, and it can swing one way or the other depending on the social and political climate.

Once we conceptualize infrastructures not just in terms of the different places that they connect, but as spatiotemporal projects—as chronotopes—then we can open up new ways of thinking about the temporality and spatiality of infrastructure. As opposed to the “finished” product of a planner's map, if we think of infrastructures as unfolding over many different moments with uneven temporalities, we get a picture in which the social and political are as important as the technical and logistical (Gupta, this volume). Another way to say this is that conceptualizing infrastructure as a process over time ensures that the technical and logistical sides of infrastructure are not privileged over, or seen as separate from, its social and political, or formal and aesthetic sides

(Larkin, this volume; Schwenkel, this volume). Paying attention to the temporality of infrastructure makes us aware that the same technical features can produce very different configurations of space and sociality than those designed by planners. Many projects do not work out as planned because, as they are implemented, social and political pressures force alterations in their design and in their function.

A processual view of infrastructure focuses on infrastructure's protean forms (Star and Ruhleder 1996; Graham 2010). Looking both across and even within the different phases of infrastructure's life span—design, financing, construction, completion, maintenance, repair, breakdown, obsolescence, ruin—one can see the operation of multiple temporalities and trajectories. For example, as Gupta's essay in this volume points out, once an infrastructure project is started, it does not necessarily have to be completed. It can be suspended or abandoned, delayed or deferred. Abandonment and suspension can result from social and political struggles regarding the project, or they can be an outcome of technical, political, and financial failures.

Even after a project is completed, it is always changing. These changes are due to the materiality of the infrastructure itself. Decay and deterioration affect all materials. For instance, pipes made of steel, copper, or PVC will have different rates and probabilities of failure over time. The life cycle of materials may create high or low probabilities of breakdowns and ruptures. And yet, however important materials may be for explaining failures, referring to the qualities of materials in isolation is insufficient. Time and infrastructural life spans are made relevant through historical relations with others.

We also have to take into account gaps in knowledge or a lack of resources for routine maintenance. More importantly, the social and political life of infrastructure changes over time. With the rise of air travel, railway stations decline in importance. Similarly, gas stations may become less ubiquitous with the move to electric cars. Highways and metro lines often split existing communities or are used in processes of gentrification to displace certain residents and welcome others (Winner 1999; Graham and Marvin 2001). And what happens when highways or train lines are discontinued? When infrastructures seem to disappear? In an essay originally prepared for the project from which this volume emerged, Catherine Fennell asks what new kinds of sociality and obligation come into being when infrastructure is abandoned (Fennell n.d.)? Her essay on house demolition in the United States' late industrial Midwest underlines the point that abandonment is not a moment but a process. As urban housing stock is razed, political controversies and public health concerns rise alongside dusts released through the destruction of cities considered