The Politics and Poetics of Infrastructure

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Abstract

Infrastructures are material forms that allow for the possibility of exchange over space. They are the physical networks through which goods, ideas, waste, power, people, and finance are trafficked. In this article I trace the range of anthropological literature that seeks to theorize infrastructure by drawing on biopolitics, science and technology studies, and theories of technopolitics. I also examine other dimensions of infrastructures that release different meanings and structure politics in various ways: through the aesthetic and the sensorial, desire and promise.

INTRODUCTION

Infrastructures are built networks that facilitate the flow of goods, people, or ideas and allow for their exchange over space. As physical forms they shape the nature of a network, the speed and direction of its movement, its temporalities, and its vulnerability to breakdown. They comprise the architecture for circulation, literally providing the undergirding of modern societies, and they generate the ambient environment of everyday life. Until recently, anthropology has had little to say about infrastructures, but in the past decade new intellectual directions in the discipline have begun to make the issue of infrastructures central. In this article I assess what an analysis of infrastructures offers to anthropological analysis and what anthropology adds to the study of infrastructures.

Although for years anthropology has played with the metaphor of infrastructure to refer to everything from Marxist analyses of base/superstructure relations to Saussure's *langue/parole* distinction, to any system that appears to underlie and give rise to the phenomenal world (culture, episteme, social structure), one can argue that anthropology finds it difficult—ethnographically—to analyze technological systems, per se. Our disciplinary bent is to examine the influence of a road in this part of Peru (Harvey 2012) or that part of Niger (Masquelier 2002) rather than to analyze road building as a network.[1] A systems analysis in this regard demands an ethnographic retooling, one in which ethnography might need to be conducted in government centers far from where the actual roads are constructed and might take into account politicians, technocrats, economists, engineers, and road builders, as well as road users themselves. But, as Latour (1993) noted long ago, this approach is a strength as well as a weakness for the discipline because it highlights other fields into which infrastructures bleed. It creates room to understand the role of breakdown and forms of life to which breakdown gives rise (Kockelman 2010, Larkin 2008). Anthropology certainly needs to understand systems thinking to build an ethnography of infrastructure, and I assess some of the best work pushing in this direction (Appel 2012b, Anand 2011, Bear 2007, Collier 2011, Von Schnitzler 2008). But it also needs to maintain its focus on contingency, the ways in which forms of infrastructure can offer insights into other domains such as practices of government, religion, or sociality.

Perhaps the most dynamic approach to studying infrastructures in current anthropology has come through the concept of technopolitics. As several scholars have pointed out, liberalism is a form of government that disavows itself, seeking to organize populations and territories through technological domains that seem far removed from formal political institutions (Barry 2001; Joyce 2003; Mitchell 2002, 2011). Even the free flow of goods that constitutes a laissez-faire economy rests on an infrastructural base that organizes both market and society. Scholars have sought to draw on science and technology studies to trace out the material operation of these technologies and the ways in which this materiality has consequences for political processes (Bennett 2010, Callon 1998, Latour 2007, Mitchell 2011). Infrastructures, in this work, are interesting because they reveal forms of political rationality that underlie technological projects and which give rise to an "apparatus of governmentality" (Foucault 2010, p. 70).

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[1]Even though it is only recently that anthropology is beginning to analyze infrastructure as a concept (Anand 2011, 2012; Appel 2012a,b; Carse 2012; Chalfin 2010; Collier 2011; Collier & Lakoff 2008; Dalakoglou & Harvey 2012; Elyachar 2010, 2011; Harvey 2012; Harvey & Knox 2012; Humphrey 2005; Mains 2012; Pedersen 2011; Sneath 2009; Sneath et al. 2009; Von Schnitzler 2008; Winther 2008), the literature has long analyzed specific technologies. These include dams (Campregher 2010, Ghosh 2008, Mains 2012), cars (Chalfin 2008, Sanders 2008, Verrips & Meyer 2001), and what is an excellent literature on roads (Dalakoglou 2010, 2012; Dalakoglou & Harvey 2012; Harvey 2010; Harvey & Knox 2012; Kernaghan 2012; Khan 2006; Knox & Harvey 2011; Mains 2012; Manning 2012; Masquelier 1992, 2002, 2008; Morris 2010; Roseman 1996). The strength of this work is seen in several recent book-length studies of infrastructural projects (Bear 2007, Limbert 2010, Winther 2008).

But infrastructures also exist as forms separate from their purely technical functioning, and they need to be analyzed as concrete semiotic and aesthetic vehicles oriented to addressees. They emerge out of and store within them forms of desire and fantasy and can take on fetish-like aspects that sometimes can be wholly autonomous from their technical function. Focusing on the issue of form, or the poetics of infrastructure, allows us to understand how the political can be constituted through different means. It points to the sense of desire and possibility, what Benjamin (1999) would term the collective fantasy of society (De Boeck 2011, Humphrey 2005, Khan 2006, Larkin 2008, Mrázek 2002, Sneath et al. 2009). It also means being alive to the formal dimensions of infrastructures, understanding what sort of semiotic objects they are, and determining how they address and constitute subjects, as well as their technical operations.

THE ONTOLOGY OF INFRASTRUCTURE

Infrastructures are matter that enable the movement of other matter. Their peculiar ontology lies in the facts that they are things and also the relation between things. As things they are present to the senses, yet they are also displaced in the focus on the matter they move around. We often see computers not cables, light not electricity, taps and water but not pipes and sewers. As technological objects they demand to be examined in the long tradition of theorizing technology (Giedion 1969, Heidegger 1977, Marx 1990, Mumford 2010, Simondon 1980 [1958], Stiegler 1998). Yet the duality of infrastructures indicates that when they operate systemically they cannot be theorized in terms of the object alone. What distinguishes infrastructures from technologies is that they are objects that create the grounds on which other objects operate, and when they do so they operate as systems.[2]

Perhaps because of this duality, infrastructures are conceptually unruly. One dominant way to think of them is as a "system of substrates" (Star 1999, p. 380) that underlies the built phenomenal world such as pipes, cables, sewers, and wires. This view presumes a clear, linear relationship between an underlying system and the phenomenal world to which it gives rise when this relationship is often far more difficult to define. Take, for example, the computer I have used to write this article. What is its infrastructure? Electricity may be the most obvious substratum that allows the computer to operate. But, as Edwards (1998) notes, although electricity is the infrastructure of the computer, the computer is the infrastructure of electricity supply, as the entire transmission industry is regulated by computers. Electricity, in turn, has other infrastructures, which can include oil production (Appel 2012a,b; E. Gelber, submitted manuscript, "Black Oil Business: Rogue Pipelines, Hydrocarbon Dealers and the Economics of Oil Theft") required for power plants to operate, financial mechanisms innovated in the wake of decentralization that allow electricity to be sold on an open market, or the labor networks necessary to produce and transmit power.

Our study of infrastructure might thus center on built things, knowledge things, or people things. One could borrow from actor-network theory to analyze all together as disparate elements of a single system, but the issue remains about which elements comprise that system and which are excluded. Electricity, after all, is only one of many other infrastructures that underlie the computer: the system of telematics that allow it to transmit and receive information (Graham & Marvin 1996), software protocols that delimit how the machine can be used (Chun 2008, Galloway 2006), and the educational and cultural competence needed to understand its functioning and to operate it. All these substrata are necessary for the computer to operate. The simple linear relation

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[2]Fisch's (2013) analysis of the Tokyo subway system as a postcybernetic technological ensemble is one important analysis in this regard.

of foundation to visible object turns out to be recursive and dispersed. Given the ever-proliferating networks that can be mobilized to understand infrastructures, we are reminded that discussing an infrastructure is a categorical act. It is a moment of tearing into those heterogeneous networks to define which aspect of which network is to be discussed and which parts will be ignored. It recognizes that infrastructures operate on differing levels simultaneously, generating multiple forms of address, and that any particular set of intellectual questions will have to select which of these levels to examine. Infrastructures are not, in any positivist sense, simply "out there." The act of defining an infrastructure is a categorizing moment. Taken thoughtfully, it comprises a cultural analytic that highlights the epistemological and political commitments involved in selecting what one sees as infrastructural (and thus causal) and what one leaves out.

SYSTEMS THINKING AND TECHNOPOLITICS

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 (Graham & Marvin 1996, 2001; Lefebvre 1991). Graham & Marvin (1996) have written a series of influential works examining how new systems of telecommunications are reconfiguring urban space and how infrastructures bundle together water, energy, people, and streets into a series of networked infrastructures that define modern life (2001). The emphasis here is on the formation of what Hughes (1987, 1993) terms large-scale technical systems, the massive infrastructural networks that have come to organize everyday life. Hughes (1987, 1993) and those coming in his wake (Bijker 1997; Bijker et al. 1987; Bowker & Star 2000; Edwards 1997, 2003; Edwards et al. 2009; Hecht 2011; Jackson et al. 2007; Star & Ruhleder 1996; Yates 1993) argue that infrastructures typically begin as a series of small, independent technologies with widely varying technical standards. They become infrastructures when either one technological system comes to dominate over others or when independent systems converge into a network. For Hughes, as a systems thinker, the ontology of a technology is composed of elements internal to the object itself but is formed as part of a system. The invention of the Edison light bulb, for instance, simultaneously involved the invention of the Edison Jumbo Generator and the Edison Main and Feeder. It innovated financial instruments and management structures necessary to accommodate a rapidly expanding corporation. The light bulb in this conception does not develop from an unfolding of elements internal to the technology itself—an assemblage of glass, filament, and vacuum—as some theories of technics would have it. Rather, as an infrastructure it is an amalgam of technical, administrative, and financial techniques.

Two major insights that emerge from this work are of central importance to anthropology. Placing the system at the center of analysis decenters a focus on technology and offers a more synthetic perspective, bringing into our conception of machines all sorts of nontechnological elements. For Hughes, a holding company or an accounting practice is as much a technical invention as is a dynamo or a telephone, and all are essential to producing an infrastructural system. Second, the focus is on system building. A technical system originates in one place, growing in response to particular ecological, legal, political, and industrial techniques native to that area. But as it grows into a networked infrastructure, it must move to other places with differing conditions, technological standards, and legal regulations, elaborating techniques of adaptation and translation. This conception places focus on practices of routinization and extension, requiring an account of translation (which can be technical, but also managerial and financial) as a process inherent to system building. It is no surprise that the scholars coming after Hughes (Bowker & Star 2000,

Edwards et al. 2009) drew heavily on actor-network theory and its emphasis on tracing associations between heterogeneous networks (Latour 1996, 2007) and on the necessity of accounting for how translation occurs (Callon 1986, 1998; Latour 1993). This work has been extremely productive for recent anthropological research (Appel 2012a,b; Anand 2011, 2012; Carse 2012; Collier 2011; Collier & Lakoff 2008; Von Schnitzler 2008), as one can see in two excellent recent studies on water supply in Mumbai (Anand 2011, 2012) and Soweto (Von Schnitzler 2008).

Anand's ethnography draws together engineers, political fixers, slum dwellers, politicians, activists, and bureaucrats into a single system through the technical operation of water supply (see also Gandy 2008, Graham et al. 2013). In Mumbai, the density of the population causes water supply to be scarce and periodic. Municipal engineers account for this limitation in technical terms (locating slums on a hilltop, the pressure required to move water great distances), but for slum residents it is an issue of political mobilization. Slums without water engage *dadas*, powerful patrons who use their connections to pressure elected officials to provide infrastructural connection. In return, the *dada* rewards those representatives by delivering electoral support.

In Anand's analysis, essentially two infrastructural systems interact: water delivery, with its systems of pipes, engineers, and bureaucracy that make up the technical end of water provision (the aspect of infrastructural supply that constitutes the entire large-scale system for Hughes and others); and the social networks, forms of patron-clientship, and "phatic labor" (Elyachar 2010) that are as important to water delivery as are pumps and pipes. Infrastructure in this sense is a kind of mentality and way of living in the world (Hansen & Verkaaik 2009, Simmel 1972, Simone 2001), and Anand (2011) brings together these two differing conceptions of infrastructure not, in the final instance, to analyze water supply but to reveal the production of what he terms "hydraulic citizenship, a form of belonging to the city enabled by social and material claims made to the city's water infrastructure" (p. 545).

Von Schnitzler (2008), like Anand, sees water supply as revealing a larger logic of citizenship in the postapartheid state in South Africa. But her approach differs by focusing analysis on a specific technology, the water meter, which was introduced as a technical device to monitor water usage and end the problem of wastage in townships. Von Schnitzler traces the technical history of the water meter back to its invention in Britain but then examines how its introduction to South Africa was intended not just to regulate water use but to produce a new sort of citizen. This citizen was one who was responsible, self-monitored his or her own actions, and engaged in practices of calculation. Taking a more biopolitical turn, Von Schnitzler argues that meters do not just regulate water provision; they reveal a strategy of government and, ultimately, produce an ethics. "[C]ouched in a moral-pedagogical language" (Von Schnitzler 2008, p. 906) city officials aimed to reform the culture of township residents (who wasted water) by producing a "calculating subject," one who switches the tap off when brushing teeth or reuses bath water when flushing the toilet (see also Fennell 2011). The meter, Von Schnitzler argues, delivered moral behavior as well as water. Both Von Schnitzler and Anand demonstrate how the operation of technologies, ostensibly a neutral practice, becomes the grounds around which forms of citizenship are contested (Barry 2001; Joyce 2003; Mitchell 2002, 2011; Otter 2008) and where technological systems are entangled with other religious and political domains.

Collier (2011) adds a twist to this literature by organizing his analysis of infrastructures entirely around the question of the biopolitical (Foucault 2010, 2011). Infrastructures, for Collier, are a mixture of political rationality, administrative techniques, and material systems, and his interest is not in infrastructure per se but in what it tells us about practices of government. Soviet electricity provision, through this lens, is analyzed for how it reveals a system of total planning in a command economy rather than for what it tells us about the effects of electricity on users in Russia. Unlike

in the West, electricity supply in Soviet Russia was not regulated by user demand but was an allocation to a particular area decided in advance by technocrats as part of a total system of electricity planning. The post-Soviet transition required a dismantling of this idea of government and a reconceptualizing of society as organized around an individual consumer and his or her demands rather than around a collective assigned a fixed amount of units.

Collier (2011) redirects analysis upstream, away from the social effects of infrastructure and toward practices of conceptualization that come before the construction of the systems themselves and which are engineered into them. His interest in infrastructure, in the end, is that it allows him to track the transfer and operationalizing of economic theories that emerged in American neoliberal thought and which were imported into Russia in the wake of the post-Soviet transition. Infrastructures become the material evidence of this transfer. To study infrastructure ethnographically, for Collier, is to make economic theory as material an ethnographic object as are pipes or the social relations to which they give rise. It is an ethnography that produces different infrastructural objects, where the budget as a site of formal rationalization is as important as the brute material of technological systems. For Collier, both shed light on the styles of reasoning and the changing rationalities of biopolitical government.

THE UNBEARABLE MODERNITY OF INFRASTRUCTURE

Infrastructure has its conceptual roots in the Enlightenment idea of a world in movement and open to change where the free circulation of goods, ideas, and people created the possibility of progress (Mattelart 1996, 2000). This mode of thought is why the provision of infrastructures is so intimately caught up with the sense of shaping modern society and realizing the future. They are "mechanisms to control time," write Graham & Marvin (1996), "instigating waves of societal progress" (p. 42; Edwards 2003), and possession of electricity, railways, and running water came to define civilization itself. In this sense, it is very difficult to disentangle infrastructures from evolutionary ways of thinking not the least because this is such an intimate part of their appeal. For Marx (1990), infrastructural technologies were not just material things but enacted the course of history itself because industry was a system of machines that shunted aside "inherited evils" and "passive survivals" (p. 91) as historical development unfolded. Infrastructures were integral to the organization of a market economy and the concept of progress that was central to liberalism (Foucault 2010). Harnessing this force of history is a power so beautiful, and so compelling, that, as Freud (1989) recognized, it addresses a basic desire for human mastery.

> With every tool man is perfecting his own organs, whether motory or sensory, or is removing the limits to their functioning. Motor power places gigantic forces at his disposal, which, like his muscles, he can employ in any direction; thanks to ships and aircraft neither water nor air can hinder his movements; by means of the telescope he sees into the far distance. . . . With the help of the telephone he can hear at distances which would be respected as unattainable even in a fairy tale. . . . Man has, as it were, become a kind of prosthetic God. When he puts on all his auxiliary organs he is truly magnificent. (p. 43)

One result of this heady lineage is that it is difficult to separate an analysis of infrastructures from this sedimented history and our belief that, by promoting circulation, infrastructures bring about change, and through change they enact progress, and through progress we gain freedom. Perhaps this process explains why as objects they provoke such deep affectual commitments, particularly, but not only, in developing societies. The Czech historian Mrázek (2002) describes this experience of infrastructure as an "enthusiasm of the imagination" (p. 166), referring to

the feelings of promise that technologies such as infrastructures can stimulate.[3] A road's technical function is to transport vehicles from one place to another, promoting movement and realizing the enlightenment goal of society and economy as a space of unimpeded circulation. But it can also be an excessive fantastic object that generates desire and awe in autonomy of its technical function. Many infrastructural projects are copies, funded and constructed so that cities or nations can take part in a contemporaneous modernity by repeating infrastructural projects from elsewhere to participate in a common visual and conceptual paradigm of what it means to be modern. Dalakoglou (2010) refers to this process as infrastructural fetishism, writing of Albania, where miles of empty roads were built even though the socialist state largely prevented ownership of cars. Pedersen (2011) makes a similar argument about Russian investment in *infrastruktura* as a precondition for socialist modernity, for material and thus ideological progress. "[I]nvestment in infrastructure was . . . not rational in any narrow economic sense; instead building 'miniature metropolises' was understood as investing in a new being, a new humanity, a new cosmos" (p. 45). The detritus of failed infrastructural projects bears witness to a certain structure of feeling that constitutes the postcolonial state's imaginative investment in technology.

Roads and railways are not just technical objects then but also operate on the level of fantasy and desire. They encode the dreams of individuals and societies and are the vehicles whereby those fantasies are transmitted and made emotionally real. Benjamin similarly argued that for those who grew up with the railway, one can never analyze the thing itself but must confront, instead, one's own past, one's own desires, and the fantasies that stand as filters through which the object is seen. Indeed for Benjamin, commodities, buildings, and streets contained within them the movement of history: They were embodiments of objective historical forces, but they simultaneously enter into our unconscious and hold sway over the imagination. They form us as subjects not just on a technopolitical level but also through this mobilization of affect and the senses of desire, pride, and frustration, feelings which can be deeply political.

This mode of operating comprises an important part of infrastructure's political address—the way technologies come to represent the possibility of being modern, of having a future, or the foreclosing of that possibility and a resulting experience of abjection (Archambault 2012, Ferguson 1999)—and it happens on the individual as well as on the societal level. Barker (2005) powerfully conveys this sense in his analysis of Indonesian engineers involved in building *Palapa*, one of the first satellites to be launched by a developing nation. Barker writes of the "intense solidarity" among emerging engineers, trained at the Institute of Technology in Bandung, who were united in a single cause. "There was [no competition between students] because at that time we wanted to develop [*membangun*]" (p. 712). His description is similar to Lombardi's (1999) interviews with Brazil's first telecommunications engineers as they "spoke in reverent tones about the selfless dedication of . . . fellow workers as they fought . . . to keep Brazil at the forefront of telephonic progress" (p. 21). My own research on the history of media systems in Nigeria also revealed how modernization was, for some, a deeply heterotopic time when, for an early nationalist generation, professionals saw themselves working at the cutting edge of their industry and the height of their personal ability and thus as pushing their society into the future. Their work created a deep sense of fulfillment that made the memory of building communication infrastructures a deeply emotional one.[4]

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[3] Such an approach is well represented in the anthropological literature (Barker 2005, Humphrey 2005, Khan 2006, Lea & Pholerus 2010, Sneath 2009, Sneath et al. 2009).

[4] A wonderful example of this can be seen in the artists Joana Hadjithomas and Khalil Joreige's project, the Lebanese Rocket Society. The Society was formed in the 1960s at the time of the Apollo launching and the first Soviet manned space flight and represented an attempt by Lebanon to develop their own rocket program (see Hadjithomas & Joreige 2013). Hadjithomas and

Although massive infrastructural projects can be used to represent state power to its citizens (Chalfin 2001, 2008, 2010; Harvey 2012; Limbert 2010; Mains 2012), the political effects of these projects cannot be simply read off from their surfaces. They generate complicated emotional investments that induce a range of sometimes counterintuitive responses and distinct, if ephemeral sensibilities. Khan (2006) describes the building of the first multilane paid motorway in Pakistan, which led to the capital, Islamabad, and writes of how the project generated a disjunctive feeling in Pakistanis. There was "a certain lack of fit between the Motorway and Pakistan," she argues, because the motorway was so streamlined and fast that the "motorway's modernity far outstripped Pakistan's" (Khan 2006, p. 88). She describes a complicated scenario where the motorway represented both promise and its failure at the same time.[5] De Boeck (2011) describes a different, yet equally complicated situation wrought by the destruction of urban settlements in Kinshasa, Congo, to make way for an elite housing complex. He argues (2011) that the state "waged war" on these slum dwellers (p. 272) by brutally destroying their homes, and he sees this as a classic example of state violence against its most vulnerable citizens. Yet he also reports that many of those evicted supported the new settlement and regarded it with a sense of pride, even though they themselves represent exactly the sort of disorder that the development was designed to overcome. "Yes, we'll be the victims," one fisherman says, "but still it will be beautiful" (p. 278). It is worth pausing to consider under what conditions this statement is possible, especially when it runs counter to accepted narratives of modernization and its victims. It vivifies the complicated admixture of desire, fantasy, and pride (see also Humphrey 2005, Sneath et al. 2009) that ethnography can open up. And it forcibly reminds us that the deeply affectual relation people have to infrastructures—the senses of awe and fascination they stimulate—is an important part of their political effect.

THE DOUBLING OF INFRASTRUCTURE AND THE AESTHETICS OF ADDRESS

In Africanist anthropology and African studies, there has been detailed analysis of the process of doubling, how systems and practices operate in variance with their purported objective. Mbembe (2001) has argued that the style of private indirect government that developed in many African nations under military rule, but which extends far beyond it, operates through the constant proliferation of formal technologies of the state—budgets, contracts, job descriptions, certificates—and the realization that these bear little relation to reality (see Hull 2012 on documents). States put forth other sorts of objects—roads, factories, bridges—that also profess to have a technical function but in fact operate on a different level at the same time. Mbembe points out that often the function of awarding infrastructural projects has far more to do with gaining access to government contracts and rewarding patron-client networks than it has to do with their technical function. This is why roads disappear, factories are built but never operated, and bridges go to nowhere.

Jakobson identified the poetic as one of six different functions present in any speech act (emotive, referential, phatic, etc.). What distinguishes the poetic is when a speech act is organized according to the material qualities of the signifier itself rather than to its referential meaning. It is when the

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Joreige view such a project for a small developing nation as a fantastic endeavor, but they also take seriously the scientific effort that went into it (see Redfield 2000 for a related project). Redfield argues that the desire to mimic technological projects as a means to assert a nation's participation at the forefront of modernity is an aspect of all space programs. The only difference is the degree to which one group feels in "advance" or "catching up" to others (P. Redfield, personal communication).

[5]Limbert (2010) also discusses the unease and disjunctive feelings modern infrastructures produce. She argues that infrastructures produced through oil monies generate a distinctive feeling of time—the time of oil—in which modernization has to occur before oil (and its time) runs out.

"palpability of the sign" becomes the "dominant, determining function" of a particular speech act (Jakobson 1985).[6] Poetics is thus a rearranging of the hierarchy of what signification within the speech event is dominant at any moment. Discourse operates on many levels simultaneously, but speech acts release differing meanings in their poetic function than they do in their referential or emotive functions.

In the case of infrastructures, the poetic mode means that form is loosened from technical function. Infrastructures are the means by which a state proffers these representations to its citizens and asks them to take those representations as social facts. It creates a politics of "as if" (Wedeen 1999; see also Apter 2005). The budget must act as if it were a realist representation, and those issuing and receiving it act as if it were a consequential document. In their poetic mode, budgets become "arbitrary symbolic acts" (Mbembe & Roitman 1995, p. 337) as much as techniques of governance. This notion is true anywhere but takes on particular intensity in many parts of Africa, where the gap between the public dissemination of a calculative order (e.g., size of a population, gross domestic product, etc.) is widely believed to be arbitrary. There, as Mbembe has pointed out, official job descriptions do not correspond to actual powers, positions are awarded for reasons unrelated to professional qualification, and budgets are drawn up but their execution bears little relation to them.

At these moments the state is simultaneously both present and absent. Lea & Pholeros (2010), in their essay "When is a Pipe not a Pipe," describe exactly this process in their discussion of aboriginal housing, which looks like housing but is not, in fact, housing. These are houses with pipes that do not connect to sewers and rooms that are only partially complete, "composite deceptions" as they term it (p. 191) that generate an "aesthetic order." Pipes, in this sense, turn out not to be about pipes but about their production as a representational form that allows reports to be written, budgets to be satisfied, and sponsors to be mollified. A pipe may not be attached to an effluent disposal system, but it is attached to techniques of regulation, audit, and administration. Its material form is transposed from a hollow tube to digits on a budget and words on a page, and all these forms—as hollow tube, as number, as series of letters—are pipes. All are material embodiments of a pipe in differing forms that allow them to move in differing circulatory regimes. Pipes turn out to be documents.

Recent research on Soviet rule has examined precisely the ways that rule operated as an aesthetic as well as a political project, one that constituted citizens through modes of address (Groys 2011). "Communism created ultimately effective aesthetic structures and defective economic ones," argues the art historian Vladimir Todorov (1994; see also Humphrey 2005). He refers thus to the fact that the technical effectivity of Soviet factories to produce goods was limited, but its political power to train subjects in a particular relationship to state power, to organize management structures that preserved that power, and to represent it to the people through the object of the factory itself was extensive. Under communism, Todorov (1994) argues, "factories are not built to produce commodities [but] symbolic meanings. . . . They result in a deficit of goods but an overproduction of symbolic meanings" (p. 10).

Todorov here captures something that needs to be addressed. Infrastructures operate on multiple levels concurrently. They execute technical functions (they move traffic, water, or electricity) by mediating exchange over distance and binding people and things into complex heterogeneous systems and by operating as entextualized forms that have relative autonomy from their technical

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[6]Rhyming in poetry is Jakobson's (1985) paradigmatic example. When a word is selected in a poem in order to rhyme, Jakobson argues that its referential function (what it means) is less relevant than its homophonic relation to another word (how it sounds). Poetics thus places attention on the materiality of the signifier itself.

function. To conceive of this operation as a form of poetics in the Jakobsonian sense is to rear-range the hierarchy of functions so that the aesthetic dimension of infrastructure (rather than its technical one) is dominant.

Thus many studies that begin by stating how infrastructures are invisible until they break down are fundamentally inaccurate. Infrastructures are metapragmatic objects, signs of themselves deployed in particular circulatory regimes to establish sets of effects. It is commonplace, seemingly obligatory, for almost any study of infrastructure to repeat Star's (1999) assertion that infrastructures are "by definition invisible," taken for granted, and that they only "become visible on breakdown" (p. 380; see also Collier 2011, Elyachar 2010, Graham & Marvin 2001, Larkin 2008). But this assertion is a partial truth and, as a way of describing infrastructure as a whole, flatly untenable. Invisibility is certainly one aspect of infrastructure, but it is only one and at the extreme edge of a range of visibilities that move from unseen to grand spectacles and everything in between.

The anthropological literature traces out an enormous range of ways infrastructure is often anything but invisible. Sneath (2009) argues that electricity was such a central symbol of state modernity in Mongolia that it was referred to as "Lenin's light." This view is not too dissimilar from that of Anand to whom one slum activist in Mumbai could usefully narrate a history of water supply, betraying an impressive technical knowledge; in fact, the slum's two pipes (and their sizes) were also known by the names of the politicians who supplied them (i.e., Congress Party two-inch-diameter pipe, Shiv Sena nine-inch-diameter pipe). For this system of patronage to work or for Lenin's staging of infrastructural modernity to be successful, visibility was necessary to continually renew its political effect. Winther (2008) notes that rural Zanzibari had a highly sophisticated knowledge of the electricity consumption of each appliance they owned, and Von Schnitzler cites municipal engineers referring to Sowetan residents as technological experts for their ability to disassemble, reassemble, and hack water meters. The widely acknowledged depth and sophistication of technical knowledge indicate the impossibility of these technologies fading into the background; indeed, as Carse (2012) argues, all visibility is situated and what is background for one person is a daily object of concern for another. The point is not to assert one or another status as an inherent condition of infrastructures but to examine how (in)visibility is mobilized and why. Generic statements about the invisibility of infrastructure cannot be supported. Perhaps the most striking example of this hypervisibility is Barker's (2005) description of Suharto's ceremony surrounding the launch of the Palapa satellite. Suharto held a *kris*, a ceremonial dagger used by Javanese monarchs as a symbol of their rule. The dagger was encrusted with 17 jewels (17 referring to the date of Indonesia's independence), and the button to launch the satellite was embedded as one of the jewels. Barker (2005) argues Suharto used the "satellite as a kind of modern kris . . . to unify the archipelago under his rule" (p. 706). It is difficult to conceive of an infrastructure more richly symbolic and vividly present than this.

INFRASTRUCTURAL MATERIALS AND THE PRODUCTION OF AMBIENT EXPERIENCE

A second, and relatively opposed, dimension to aesthetics offers another fruitful way to think about infrastructures, one that draws from the older Aristotelian concept of *aisthesis* (Buck-Morss 1992, Meyer 2009, Verrips 2006). Aisthesis refers not to the mental appreciation of works of art, but to a bodily reaction to lived reality: "It is a form of cognition, achieved through taste, touch, hearing, seeing, smell," Buck-Morss (1992, p. 6) argues. Aesthetics in this sense is not a representation but an embodied experience governed by the ways infrastructures produce the ambient conditions of everyday life: our sense of temperature, speed, florescence, and the ideas we have associated with

these conditions. Infrastructures create a sensing of modernity (Mrázek 2002), a process by which the body, as much as the mind, apprehends what it is to be modern, mutable, and progressive.

For Mrázek (2002), writing about the Dutch colonial Indonesia, infrastructure is not just a technical object but a language to be learned, a way of tuning into the desire and sense of possibility expressed in the very materials of infrastructure. In a way, he supports Barry's (2001) argument that a technological society is one that cultivates citizens' technical skills and knowledge as a condition of operating within a modern world.[7] But Mrázek (2002) analyzes this process in deeply aesthetic terms, focusing on how the materials of infrastructure—the hardness of the road, the intensity of its blackness, its smooth finish—produces sensorial and political experiences. "Cleanness of the roads, in this logic," he argues, "was purity of the times, democracy even" (p. 8). The building of colonial infrastructure was the imposition of hard roads—metal ones for trains, tarmac ones for cars—over the dirty, muddy, soft paths of Indonesia. These have their own startlingly new and different material properties, their own modes of accident, their own ways of redressing social and psychical relations. And they are a language that others have to learn.

The materials of infrastructure are key to Mrázek's analysis. The road, as an expression of Dutchness, was clean but a cleanliness that was continually threatened by dust. Blown when the feces of horses and buffalo dried in the hot sun, mud was also tracked onto the road via the dirty feet of native pedestrians threatening to soften the road's hardness. This problem was part of a far greater complication for the Dutch: There was too much softness in the Indies, where even the air seemed to have water in it. Tropical rain soaked, weakened, and eroded the roads. "Wherever the natives went, especially as they dared to approach a modern road, they were read and pronounced as carrying that soft stuff on themselves, on their tongues, on their feet, on their wheels" (Mrázek 2002, p. 27).

Infrastructures operate at the level of surface, what Buck-Morss (1992) refers to as the terminae of the outside of the body—skin, nose, eye, ear—rather than the mind inside. Softness, hardness, the noise of a city, its brightness, the feeling of being hot or cold are all sensorial experiences regulated by infrastructures and which have, as Mrázek indicates, far broader conceptual entanglements.

Mumford (2010) divided history up into technological periods and argued that each age has a privileged technology that comes to stand for the period. For the industrial era, iron decisively replaced wood—along with all its residue of an organic rural past—with what was the first man-made building material. "One went to sleep in an iron bed and washed one's face in . . . an iron washbowl . . . ; one sat behind an iron locomotive and drove to the city on iron rails passing over an iron bridge and arriving at an iron-covered railroad station" (Mumford 2010, p. 164). Iron has particular material qualities. Where stone resists compression, masses into piles, and closes off space, iron can be stretched and drawn, holding tremendous weight to create soaring open spaces (Giedion 1995). Its thin posts allowed the creation of vast new areas to display commodities and to circulate large crowds central to the emergence of new spaces of capital: train stations, department stores, exhibition halls (Giedion 1995, Benjamin 1999). There is an affinity between the industrial process that produces iron, the aesthetic spaces the material can bring into being, and the new forms of display central to a consumer society. Anyone walking through a train station or

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[7]The idea that an infrastructure is a language or, more usually, a set of cultural competences to be learned is explored in several works (Harvey 2010, Khan 2006, Lea & Pholerus 2010, von Schnitzler 2008, Winther 2008). Usually this notion centers around the failure of people to have "learned the language" of living in a modern way (Lea & Pholeros 2010), accusations often levied by government officials and engineers who imply that people do not know how to take care of the technologies they have. It supports Barry's point that the technological involves modes of competence and disposition far from technology itself.

ascending an escalator in a department store was moving in a space entirely captured and formed by industrialism (Benjamin 1999, Giedion 1995, Marx 1990).

Schivelbusch (1995) notes that the shift from open flame to incandescent lighting replaced a flickering, variable, dynamic light source with a hard disembodied, steady one. He argues that this change produced a subtle yet thoroughgoing shift in the everyday perceptual world. Otter (2008) echoes this sentiment in his account of the laying of the first asphalt road in London in 1869 and the reaction it produced. For contemporaries, it created an almost eerie effect of soundlessness. It was as if they were soundproofing the city from the noise of iron-covered carriage wheels over cobbles. Concrete is another universal building material with particular tactile qualities that shape ambient life. Harvey (2010) argues that in the case of road building in Peru, concrete rubbed against Andean conceptions of dehydration and vitality. Concrete was considered distinct because as a substance it is mutable but irreversibly hardens by drying (Taussig 2004), operating in an Andean region where techniques of dehydration (mummification) have been central to the stored vitality of the dead (Harvey 2010, p. 38). Harvey argues that the hardness of concrete questions foundational cosmological certainties concerning stone, earth, rocks, and mountains.

The materials of infrastructure—iron, mud, concrete, fiber optic cables, plastic—both stand for an era, in the sense that iron was the exemplary material of the nineteenth century, and also bring about a sensory apprehension of existence. This is their aesthetic dimension. Ranciere (2006, 2009) sees aesthetics as a property of art and grants to art the critical potential to reconfigure the territory of the common and allow for the insertion of new voices into political space. But almost a century earlier, Giedion (1995) disassociates this attribute from art and gives it instead to the infrastructures that underlie it. For him, the revolution in building material brought by the rise of iron and concrete meant that iron "breaks through" architecture. Infrastructural materials and the forces of production they embody outstrip architecture, revealing its naturalized basis, offering revelation into the state of things, and shaping the emergence of modern subjects. "Construction in the nineteenth century plays the role of the subconscious. Outwardly, construction still boasts the old pathos: underneath, concealed behind facades, the basis of our present existence is taking shape" (Giedion 1995, p. 87; see also Benjamin 1999). Fennell (2011), examining the very different situation of public housing heating systems in Chicago, conceives of this infrastructure as a "sensory politics." "Project heat," as residents called it, referred to the constant levels of high heat former residents of housing projects enjoyed before their units were destroyed and residents were rehoused. As one elderly man told Fennell, "We had summertime in wintertime" (2011, p. 50), and "project heat" represented a kind of Platonic essence of heating systems. Fennell argues that it also became the grounds on which to assess the benefits, risks, and consequences of the destruction and construction of public housing in a liberal era. For Fennell, heating is a sensory, affectual experience through which political subjectivity is enacted and claims for political recognition expressed.

CONCLUSION

Because the basic object of infrastructure is so diverse and can be analyzed in so many different ways, the choice of methodology is a theoretical question. Are infrastructures technological systems, and the way to understand them a process of analyzing networked machines? Are they financial instruments, practices of accounting and budgets, or management structures and organizational techniques? Are they biological, embodied in the physicality of men who use their size, mass, and attitude to attract bids on a Chicago trading floor (Zaloom 2003, 2006)? Or are they social, composed of practices of visiting, drinking tea, and greeting, investments into sociality that can pay off by creating a web of connections that can be relied on for all sorts of social, economic, and

political work (Elyachar 2010, 2011; Simone 1998, 2001, 2004)? Studies of infrastructure tend to privilege the technological even if they qualify it by defining urban spaces as hybrid systems of humans and machines bundled together through infrastructural networks. Yet one of the most dynamic aspects of recent anthropological research on infrastructure is the sheer diversity of ways to conceive of and analyze infrastructures that cumulatively point to the productive instability of the basic unit of research.

I am only barely able to discuss here many other approaches to infrastructure. Deleuze (1992) argues—not unlike Mumford—that types of machines can be matched to types of societies; and if the nineteenth century was built on industrial technologies of enclosure, the twentieth and twenty-first centuries are built on structures of control mediated through the computer. This is a decisively cybernetic turn only recently taken up in anthropology in Fisch's (2013) study of the Tokyo subway system. In this society, production has been outsourced, value is produced virtually, infrastructures lie in computer protocols, and the forms of capture engineered into social media platforms, such as Facebook and Google. In this economy the regulation of attention is central to the production of value (Chun 2008, Galloway 2006). Other research examines the media infrastructures of activism, the architectures and practices of circulation by which political ideas are encoded into medial forms, embedded in campaigns and thus made public (Keenan & Weizman 2012; Latour & Weibel 2005; McLagan 2006, 2008; McLagan & McKee 2012). One can point to other literatures on planning and space too numerous to list, but media represent a particularly compelling case given their centrality to the production of emergent forms of value.

Beller (2006) argued that the rise of cinema represented a transformation in value production away from an industrial economy and toward the stimulation of desire and, through that shift, consumption. "Rather than requiring a State to build the roads that enable the circulation of its commodities, as did Ford, the cinema builds its pathways of circulation directly into the eyes and sensoriums of its viewers. It is the viewers who perform the labor that opens the pathways for new commodities" (Beller 2006, p. 209). If this were true for modern society, it has multiplied in our age of social media, in which control and value are indissolubly linked to the machine ensembles that comprise contemporary digital infrastructures. For that, a new ethnographic and theoretical frame has yet to be devised in anthropology.

DISCLOSURE STATEMENT

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