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Mutability, Mobility, Worlding

Appropriate infrastructure and urban sociotechnical change in Ahmedabad, Gujarat

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I hereby declare that this thesis has not been and will not be submitted, in whole or in part, to this or any other university for a degree.

Thesis abstract

This thesis investigates the relationship between urban infrastructure and sociotechnical change. Drawing on 10 months of field research in the city of Ahmedabad, in Gujarat, the study provides an account of relations between infrastructural undertakings and their contexts, and how these shape subsequent patterns of continuity and change. This connection, I argue, is particularly apparent in the urban milieu, where planners have to contend with existing infrastructure as part of the built environment. Supplementing this interpretive account, the study draws on post-war writings on appropriate technology, working to update and evaluate the utility of 'appropriateness' as a criterion for evaluating infrastructure projects, particularly those implemented in an urban or postcolonial setting.

Identifying infrastructure as a slippery, opaque, and often invisible research subject —something exceeding representational writing and the single, clearly-bounded field site —the study adopts a research methodology inspired by practices of *flânerie*, deploying observational techniques, practices of urban walking, and performative modes of writing to trace the configuration of specific infrastructure projects and processes of urban change. Drawing on recent work on infrastructure from anthropology, STS, urban geography, and policy studies, the study mobilises a range of concepts to further illuminate the status of objects and events encountered in the city, and situating them in relation to broader processes of change and transformation.

In developing this account, and moving from description to theory, the thesis addresses three sets of relational dynamics—mutability, mobility, and worlding. The first of these dynamics looks at the mutability of a given system or artefact, its capacity for adaptive modification, or, conversely, its resistance to change. The second addresses how infrastructures are transferred from one setting to another, paying attention to the pressures of new or unforeseen contexts of use. The third examines how understandings of context are enacted through the 'worlding' of infrastructure and urban technology— exploring situations where different actors' worldings compete or exist in tension with one another.

As observed in Ahmedabad, a postcolonial 'mega-city' and home to a new, emerging urban middle class, these dynamics complicate the relationship between infrastructure

and its contexts—interactions shaped by crosscutting obdurate and fluid materialities ('mutability'), enmeshed in global circuits of transport and exchange ('mobility'), and materialising various forms of identity and affiliation ('worlding'). Mobilising 'appropriateness' as a norm and evaluative criteria, and reflecting on the likely characteristics of 'appropriate infrastructure', is, I conclude, an effective way to foreground these neglected dimensions, and, in doing so, contribute to future work on urban transformations and infrastructural change.

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Chapter 1: Introduction

> 'Gandhi was fortunate. He entered the realm of technology as cook, nurse and weaver, not as a high-brow engineer.'
>
> Shiv Visvanathan, *A Carnival for Science* (1997: 230)

1.1. Introduction: Smart City, World Heritage City

In January 2016, Ahmedabad, in the state of Gujarat, was announced as one of the first 20 cities to be included in the Indian government's flagship National Smart Cities Mission. For Ahmedabad, 'smart city' status unlocked central government funding to 'upgrade' a 590-acre site in the city's Wadaj neighbourhood; retrofitting most of this space as a higher density 'transit-oriented zone', flanking a corridor used by the city's Janmarg Bus Rapid Transit system[1], and redeveloping of a smaller, 75-acre slum, replacing the existing built environment and adding new 'smart features'. (Ministry of Urban Development, 2016: 24) Alongside these area-based interventions, the smart city designation also funded a 'pan-city' smart transit platform with a 'common card payment system' and web and mobile apps, and a central command centre, using fibre optics to connect city government offices, civic and health centres, schools, and municipal buildings. (ibid: 45) Qualifying bids, including Ahmedabad's, had also had to provide 'core infrastructure elements'—a checklist including assured electricity supply (10% from solar), water provision, sanitation and solid waste management, rainwater harvesting, smart metering, robust IT connectivity, pedestrian-friendly pathways, and energy-efficient street lighting, among other items. (Ministry of Urban Development, 2015)

18 months later, in July 2017, Ahmedabad's historic centre was added to the list of UNESCO World Heritage Sites, as India's first World Heritage City. The culmination of 20 years of lobbying and activism by local actors, this award covered the area of the historic walled city, including gates (*darwajas*), surviving fragments of fortification, and the footprints of the demolished city walls. (AMC, 2016: 1) Although the designation conferred little practical advantage, the additional prestige was expected to help gain the attention of investors and donors. (Meskell and Brumman, 2015: 26) News of Ahmedabad's selection,

[1] See Chapter 6, pp. 139–142.

and its triumph over competing bids from Mumbai and Delhi (Kumar, 2017), was received with celebration by those on the ground (see, for example, Figure 1)—but also some scepticism from those who felt the euphoria was unearned[2], or that the real work was still to come. (cf. Chapagain, 2017)

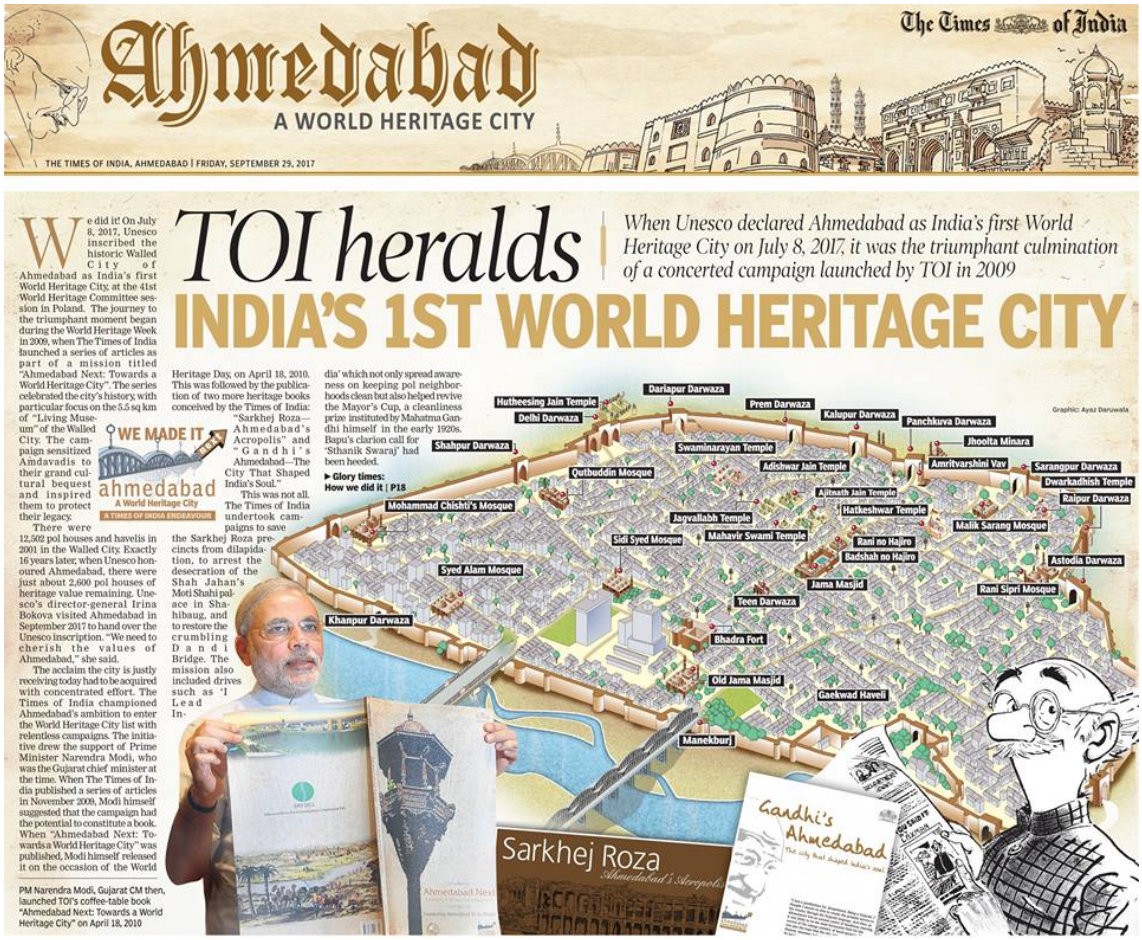

Figure 1. *Times of India* heralds India's 1st World Heritage City, 29 September 2017.

A designation granted to fixed sites, rather than objects or cultural practices, the UNESCO World Heritage label subjects specific 'local' places to a 'global' valuation regime. (Brumann and Berliner, 2016: 2) In recent decades, UNESCO's committee have often favoured sites that embody cosmopolitan values, reflecting the interplay of different

[2] The decision to inscribe Ahmedabad's old city earned the support of national representatives, but failed to address the concerns of the International Council on Monuments and Sites, who had recommended the nomination be deferred; noting how, e.g., 'commercial development and traffic congestion' had caused many original inhabitants to vacate the area, with implications for maintenance and conservation. (ICOMOS, 2017: 120)

societies and cultures. (Brumann, 2014: 2181) In Ahmedabad's bid, the value of the walled city was justified in reference to features demonstrating the area's 'multi-cultural character', 'community organisational network[s]'[3], and histories of religious and cultural 'co-existence' (AMC, 2016: 1-2). Seeking points of distinction, the city's nomination dossier also cited the prevalence of wood carving and timber-based architecture, the survival of the *pol* house as a 'self-sufficient unit with its own provisions for water, sanitation, and climatic control'[4] (ibid: 4), and material evidence of the patronage of arts and architecture by the city's early rulers. The proposal for smart city funding, meanwhile, required bidders to cite models and best practices from other cities. In Ahmedabad's case, the authors noted their proposed pan-city solutions had not yet 'gained traction' in the 'Indian ecosystem', leading them to reference, instead, command centre models from Glasgow and Rio de Janeiro[5], Stockholm's 'Stokab'' fibre optic network, and Singapore's integrated transit management system. (Ministry of Urban Development, 2016: 55)

Appealing, by turn, to distinctive local features and modern, high-tech models from elsewhere, these two bids appear to pull in different directions. Both projects, however, emerged from a common political context, capitalising on the policy initiatives and priorities of Narendra Modi during his tenure as Chief Minister of Gujarat (2001–14). Widely hailed for their so-called 'Gujarat model' of development, Modi and his allies sustained high economic growth rates across different sectors, even as human development indicators lagged, and the gap between rich and poor grew wider. (cf. Jaffrelot, 2015b; Sud, 2022) Pursuing development through modernisation, the Bharatiya Janata Party (BJP) state government pursued urban development and infrastructure projects that sought to turn the city into an outward facing 'storefront' for foreign capital investment. (Bobbio, 2012: 662) As part of this agenda, earlier smart city projects in Gujarat relied on the state government to create a favourable investment environment, marshalling different funding sources to support infrastructure-led growth.[6] (Hoelscher, 2016; Nair and Sirur, 2021) At the same time, state support for heritage conservation and cultural production helped facilitate a wider restructuring of Ahmedabad to the advantage of business and an emerging urban middle class. (cf. Da Costa, 2015; Mehta, 2016)

[3] Evident in the walled city's cellular *pol* morphology; see p. 56.
[4] On historic systems supporting household-scale water provision, see pp. 131–132.
[5] For more detail on the referenced Glasgow Operations Centre as a 'flagship space', see Caprotti (2019); for more on the model adopted in Rio de Janeiro, see Gaffney and Robertson (2016).
[6] One such project was GIFT City (Gujarat International Finance Tec-City), a prominent initiative to build a new central business district on Ahmedabad's outskirts, in anticipation of the city's future merger with the state capital, Gandhinagar. (Mehta, 2016: 198; Nair and Sirur, 2021)

Responding to a dominant perception of Ahmedabad's historic core as a run down, poorly maintained source of disorder[7], those pushing for UNESCO World Heritage status hoped to tell an alternative story of 'social cohesion and harmony', attracting tourists and visitors by appealing to the city's history and culture. (Thomas, 2016a: 144)

The relatively quick succession of these two announcements, initiating projects to reconfigure different areas of the city, poses questions about the interactions of infrastructure and urban change, and efforts to apply 'global' models and best practices in specific, local settings. Where UNESCO World Heritage status bolstered efforts to conserve a clearly bounded historic urban area, shielding it from future development pressures, Ahmedabad's smart city plans envisaged the retrofit and redevelopment of a less valued space. Both sets of designations required the local implementation of globally indexed models, through heritage conservation practices first developed in the West, and 'world-class' visions of technologically mediated 'smart' urbanism.

1.2. Research objectives

This thesis explores infrastructure and urban development in Ahmedabad, the largest city in the Indian state of Gujarat, using material gathered during 10 months of fieldwork conducted during two visits to the city spanning 2015 and 2016. The resulting accounts present encounters and material details from a city that served as the 'laboratory' for a novel coupling of majoritarian Hindutva politics and entrepreneurial neoliberalism[8], later applied at the national scale. I arrived in Ahmedabad in January 2015[9], eight months after the 2014 Indian general election, which saw Narendra Modi vacate his role as Chief Minister of Gujarat to become India's Prime Minister.

Occupying the attenuated aftermath of the touted 'Gujarat model' of development (Jaffrelot, 2015b), this study focuses on Ahmedabad's built environment, the implementation of new, 'global' infrastructure models, and how these were made or remade to better suit their environments. Using research methods derived from the mobile and observational practices of *flânerie*[10], the following chapters explore the connections between urban infrastructures and their contexts, probing relations of

[7] Including the 2002 Muslim pogrom and its aftermath; see Chapter 4, pp. 57–58.
[8] For more on the conjuncture of economic reforms and Hindu nationalism, see pp. 71–72.
[9] After a pilot visit with local friends in January 2014.
[10] See Chapter 5.

mutability and mobility, and different constructions of 'appropriateness'. My hypothesis is that these factors have contributed to the success or failure of infrastructure projects in Ahmedabad and elsewhere, a connection with implications for policy and practice.

With these as my objectives, this study poses the following questions:

1. What factors explain the success or failure of urban infrastructure projects? How does infrastructure respond to, or encounter resistance from, its setting or context?
2. Is 'appropriateness' a useful lens for the analysis of infrastructure, and/or a normative criterion for evaluating projects? What would be the qualities or characteristics of an 'appropriate infrastructure', and would it be recognisable as such?
3. What is distinctive about conducting this research in Ahmedabad, and which identified factors are likely to hold across different settings? What does it mean to ask these questions of infrastructure, as contrasted with other forms of technology? What is distinctive about cities and urban space, as a locus and focus for change? How does India's postcolonial history and experience shape these questions, and their answers?

Much existing research on the dynamics of sociotechnical change has relegated infrastructure to the background, with claims of its relative 'invisibility' (cf. Star, 1999) supporting its bracketing as part of the operational environment; a foundation or base for nimbler, faster-moving patterns of social practice, entrepreneurship, or innovation. Infrastructure's high capital costs have resulted in such systems being perceived as beyond relevant actors' control, with theoretical and practical discussions emphasising questions around obduracy, momentum, lock-in, and other forms of technological resistance.[11] In addressing the above research questions, this study focuses on the relations between infrastructure and patterns of continuity and change; connections more clearly visible in urban and postcolonial settings, where dominant, Euro-American infrastructural assumptions and 'conventional' local contexts may not hold. (cf. Morita, 2014: 219)

[11] See Chapters 2 and 3.

1.3. Chapter outline

Having introduced the study, Chapter 2 ('Infrastructure and sociotechnical change') establishes a theoretical context for my research, relating my focus on infrastructure and urban change to existing disciplinary and literature formations. I provide an overview of the trajectory of ethnographic research on infrastructure, attending to claims about its relative invisibility, and more recent work casing infrastructures as 'open-ended' ontological experiments. (Jensen and Morita, 2013; 2015) I also introduce several constructivist theories of sociotechnical change, which seek to explain the stabilisation of new technologies. Exploring how such frameworks can be extended to urban subjects and phenomena, this chapter reflects on several historical cases of urban reconfiguration implemented from the top down, before examine Stephen Graham and Simon Marvin's work on 'splintering urbanism' as the eclipse of an aspirational, Euro-American 'modern infrastructural ideal'. (Graham and Marvin, 2001) This chapter closes by looking at the recent popularisation of a lexicon of 'urban laboratories' and experimentation, assessing how this reflects changes in the implementation and management of infrastructure projects, and the implications of this shift for non-Western settings.

Chapter 3 ('Mutability and mobility') builds on Bruno Latour and John Law's concept of the 'immutable mobile' (Latour, 1987; Law, 1984; 1987), disaggregating mutability and mobility to investigate the composition, configuration, and movement of different infrastructures. Looking at infrastructure and the built environment's amenability to change, I turn to theories of fluidity and flexibility, the stabilisation and closure of technological artifacts, and work on obduracy, path dependency, and systemic momentum. As an alternative to linear models of technology transfer and innovation diffusion, I also introduce an account of infrastructure mobilities, referring to work on translation, policy mobilities, and users' appropriation and reconfigurations of technology. Taken together, these explorations of mutability and mobility expand the potential applications of the 'immutable mobile' and its implied variants, beyond the contexts originally suggested.

In Chapter 4 ('Locating Ahmedabad'), I introduce my research site: Ahmedabad, a city in Gujarat, northwest India, in the mid-2010s. Describing the city's location, spatial features, and urban morphology, this chapter also addresses the difficulties in reconciling single-sited, observational research with work on large, networked infrastructure and processes of urban sociotechnical change. Where the first half of this chapter focuses on the city's urban geography, the second half addresses history and temporality. I describe

how colonial rule and nationalist politics shaped Ahmedabad's development, then examine the role and status of science, technology, and infrastructure in the early years of independent India. This chapter's final sections address the opening of India's economy to foreign investment in 1991, and the 2014 Indian general election, in which Narendra Modi led the Hindu nationalist BJP to victory—two moments that reshaped India's development model, and perceived place in the world.

Chapter 5 ('Sociotechnical flânerie in the postcolonial city') outlines the study's research methods. Inspired by the figure of the *flâneur*, with its origins in the streets and covered arcades of nineteenth-century Paris (cf. Benjamin, 1999; 2006), this chapter shows how a mobile, *flânerie*-inspired approach to urban research differs from sustained, in-depth participant observation in the ethnographic and laboratory studies traditions. Examining *flânerie*'s component practices of walking, observation, knowledge production, and textual authorship, I show how these practices can be reworked to offer greater purchase on infrastructural and sociotechnical phenomena, and the further translations required to support its transposition from nineteenth-century Paris to 2010s Ahmedabad. A supplementary interlude ('Assembling whiteness') reflects on the role of race and my own whiteness as a factor mediating my research.

The first of three chapters presenting cases from my research, Chapter 6 ('Mutable infrastructures') explores the variable mutability of infrastructure, through notions of obduracy, fluidity, and material resistance. Pushing back against constructivist accounts of the stabilisation and closure of technological artifacts, this chapter shows how urban infrastructure is characterised by diverse, cross-cutting relations and mutability and obduracy, which may vary based on circumstance, or fluctuate over time. A disconcerting encounter with halogen streetlights in the *pols* of Ahmedabad's historic walled city provides an opportunity to examine how the modern infrastructural ideal reaffirms colonial hierarchies of value. Field observations of a fifteenth-century stepwell, the widespread use of rooftop storage tanks, and the renovation of an underground water cistern track how mutability can be an asset or liability, affecting a system's amenability to reconfiguration and long-term survival. The interface of a Bus Rapid Transit system constructed in the 2000s and a newer bike-sharing enterprise show how obduracy and mutability can also be relative or relational qualities, emerging through interaction. This chapter reveals the inadequacy of material properties as an explanation for a given system's mutability (or obduracy), with the capacity to adapt or respond to change also

affected by details of social practice, religious significance, political patronage, and culturally-specific hierarchies of value.

Chapter 7 ('Mobile infrastructures') looks at the movement of infrastructure and urban technology between sites, sharing cases where the arrival of 'foreign' technology elicited anxiety and enthusiasm from wider publics. The first case decodes the significance and sociocultural connotations of a satirical social media post about a Japanese-made road, drawing comparisons with the work of Indian newspaper cartoonist R.K. Laxman to explore the shifting politics of infrastructure development in independent India. Where such projects once foundered by moving too slowly, victim to market fluctuations or changing government priorities, today's interventions risk moving too quickly, short-circuiting processes of deliberation, and failing to consider local needs. This chapter's second case examines solar-powered prototype aircraft *Solar Impulse 2*'s stopover in Ahmedabad, as part of an attempted global circumnavigation. Built to circulate a business-led message of sustainable innovation, this 'foreign' aircraft's encounter with local Gujarati audiences, and later obstacles to its departure, reveals the mission's whiteness, and its ready mobilisation of colonial tropes to promote a universalising vision. This chapter challenges received linear models of technology transfer, innovation diffusion, and sociotechnical change. In both examples, failures to acknowledge local difference, disavowing the coevalness of 'innovators and their others' (Irani, 2019), added friction to the movement of technology between sites, undercutting expectations of success.

Adopting a register of 'worlding', Chapter 8 ('Worlded infrastructures') addresses the 'practical ontology' of infrastructure. (cf. Gad et al., 2015) Building on the preceding examinations of mutability and mobility, this chapter presents two cases where different actors worked to attribute 'world-like characteristics' to scenes of encounter. (Tsing, 2010: 48) The first case examines an encounter between two divergent worldings of the bicycle, using this as an opportunity to trace how class, gender, and cultural identity mediate the technology's local meaning and use. The second case extends a worlding lens to Ahmedabad's built environment. Focusing on the redevelopment of the city's Sabarmati riverfront, this case shows how planners were able to erase the space's prior uses, rendering it as a blank space amenable for development, and open to monopolisation by the city's middle class. Demonstrating how seemingly self-evident contexts are enacted through practice, this chapter develops the previous chapters' critiques of the construction and stabilisation of technology and linear, diffusionist accounts of sociotechnical change.

Following these *flânerie*-derived chapters, a short descriptive interlude ('Bungalow No. 1. to Rashtrapati Bhavan') gathers observations from my encounters with a network of Indian innovation organisations operating out of Ahmedabad. Recounting my experiences at an academic conference, a meeting with the manager of an innovation research organisation, and at India's National Festival of Innovation, these scenes track the realities of practical and political support for 'grassroots' innovation and technology. Building on this interlude, Chapter 9 ('Appropriate infrastructures') reflects on the utility of 'appropriateness' as a norm or criterion for judging infrastructure and urban development projects. Introducing earlier critiques of the transfer of 'inappropriate', capital-intensive infrastructure by supporters of 'intermediate' technology and India's anti-colonial *swadeshi* movement, I show how these approaches to technology choice enacted different normative goods. Revisiting cases from Chapters 6-8, considerations of mutability, mobility, and worlding provide a useful heuristic to examine different interpretations of 'context'. Addressing structural constraints and trade-offs between different values, I conclude by offering a provisional outline of 'appropriate infrastructure' as a portable analytic capable of disrupting hegemonic conceptions of infrastructure, and recentring user needs. Chapter 10 ('Conclusions') briefly reviews the thesis. Articulating my theoretical, normative, and methodological contributions, this chapter examines their implications for academic discourse and practice, and outlines some opportunities for future research. A final section reflects on more recent developments in India, re-evaluating my work against the backdrop of current events.

Chapter 2: Infrastructure and sociotechnical change

2.1. Introduction

This chapter establishes a theoretical context for the study, reviewing and identifying gaps in the existing literature. Where the next chapter works to populate a toolbox of concepts and theories mobilised later in my empirical chapters, this chapter limits itself to locating the study and my research questions in a broader disciplinary and theoretical context. Starting from the relationship between infrastructure and sociotechnical change, this chapter's first section reviews anthropological and ethnographic research on infrastructure. A second section aligns this project with a body of literature addressing processes of closure and stabilisation in sociotechnical change. I follow this by reviewing work on urban technology and the built environment, highlighting some historical examples of attempts to rework the morphology of particular cities, and research on the 'splintering' of urban space (Graham and Marvin, 2001). To conclude the chapter, I address an emerging body of literature on so-called 'urban laboratories' and forms of experimentation.

Throughout, I contrast established ethnographic studies of infrastructure and constructivist theories of sociotechnical change with a set of more recent relational, plural, and ontologically sensitive bodies of work, many of which are still relatively underdeveloped. In later chapters, I align myself more explicitly with the latter, more relational approach to my subjects of investigation, seen as better suited to the complexity, multiplicities, and conjunctures of my postcolonial field site. In reviewing the literature, however, a comparison of these two approaches, bringing them into dialogue, offers the possibility of 'thickening' my accounts of infrastructure and urban change.

2.2. Infrastructure

This study adopts an expansive understanding of infrastructure, avoiding strict, categorical definitions in favour of Brian Larkin's recognition of the 'productive instability' of the concept as a 'basic unit' of research. (Larkin, 2013: 339) For Larkin, infrastructure is a designation that can be extended to any in the panoply of 'built networks that facilitate the flow of goods, people, or ideas and allow for their exchange over space.' (ibid: 328)

Infrastructure, in short, is 'matter that enables the movement of other matter.' (ibid: 329) Approaching 'infrastructure' as a keyword, Ashley Carse flags the concept's unifying feature as denoting a 'plurality of integrated parts', deployed to 'support some higher-order project.' (Carse, 2017: 27) Following the word's origins in nineteenth-century French engineering cultures, he argues infrastructure diverges from conceptions of the system or network in 'suggesting relations of depth or hierarchy' (ibid.) Adopted as a loanword in English:

> 'infrastructure referred primarily to the organizational work required before railroad tracks could be laid: either establishing a roadbed of substrate material (literally beneath the tracks) or other work functionally prior to laying tracks like building bridges, embankments, and tunnels.' (Carse, 2017: 27)

In these contexts, the term's emphasis on relations of depth and hierarchy bolstered institutional efforts to 'demarcate responsibility and investment.' (ibid: 30) In nineteenth-century France and its colonies, for example, the state oversaw construction of the infrastructural base, while leaving the superstructure to private contractors and financiers. (ibid.) Today, infrastructure typically refers to the 'subordinate part of many projects' enabling the movement of, e.g., water, sewage, people, power, and goods and services. (ibid: 28)

Extending this analysis, this section reviews research that has taken an anthropological approach to the study of infrastructure. One of the most widely cited works in this area is Susan Leigh Star's 1999 article, 'The ethnography of infrastructure.' Indexing its characteristics, Star sees infrastructure is characterised by its *embeddedness*, *transparency*, *reach or scope*, that it is *learned as part of membership*, its *links with conventions of practice*, that it *embodies standards*, is *built on an installed base*, *becomes visible upon breakdown*, and *is fixed in modular increments*. (Star, 1999: 381-382) Although subsequent research questioned and critiqued certain of these assumptions, this list proved hugely influential, shaping much of the early work in this area.

For Star and those following her, a common research technique was 'infrastructural inversion' (cf. Bowker, 1995), a figure-ground shift that relegated people and things to the background of their analyses, while foregrounding the changes in infrastructural relations that, 'by design or by habit', tend to fade from view. (Bowker and Star, 1999: 34) Of Star's initial index, the most widely-contested claim has been her assertion that infrastructure only become visible when things break, or service is disrupted—when 'the server is down, the bridge washes out, there is a power blackout' (Star, 1999: 382). While Star and her

collaborators treated the *invisibility* of infrastructure as a categorical fact, later writers either have either derided such as 'a partial truth and … flatly untenable' (Larkin, 2013: 336), or else acknowledge it as something sustained 'through continual efforts of management and maintenance' (Dourish and Bell, 2007: 428). The trick, notes Larkin, 'is not to assert one or another status as an inherent condition of infrastructures but to examine how (in)visibility is mobilized and why.' (Larkin, 2013: 336) Foregrounding infrastructure's neglected symbolic and promissory dimensions, he describes how such forms exceed their 'purely technical functioning' and, as such, 'need to be analysed as concrete semiotic and aesthetic vehicles oriented to addressees.' (ibid: 329)

We might think of how infrastructure is often deeply implicated in liberal conceptions of progress and modernisation, making it difficult to step back from 'our belief that, by promoting circulation, infrastructures bring about change' (Larkin, 2013: 332); something perhaps more apparent in the global south. Engaging with a given infrastructure's 'fetish-like aspects' highlights how many systems are copies, enabling 'cities or nations [to] take part in a contemporaneous modernity by repeating infrastructural projects from elsewhere' (ibid: 329, 333)—a dynamic equally visible in the launch of a municipal Water and Electric Light Works in colonial-era Kano (Larkin, 2008b), the rapid construction of motorways in socialist Albania (Dalakoglou, 2010), and the 2004 transformation of the Laotian capital Vientane, ahead of that year's ASEAN conference. (Namba, 2017)

In the years since Brian Larkin's 2013 review essay, a volley of monographs, articles, edited volumes, and themed journal issues have signalled the mushrooming of a so-called 'infrastructural turn' in anthropology, STS, and the social sciences as a whole. Demonstrating the breadth of this literature, I here briefly review studies of water infrastructure in Mumbai (Anand, 2011; 2012; 2017b) and the opacity and uncertainty of infrastructure in the Nigerian city of Jos (Trovalla and Trovalla, 2015a; 2015b); Drawing on fieldwork and research materials from the global south, these works illustrate how the ideal of transparent infrastructure often proves flatly untenable.

Nikhil Anand's work on Mumbai posits *hydraulic citizenship* as a form of urban belonging determined by 'diverse articulations between the technology of politics (enabled by laws, politicians, and patrons) and the politics of technology (enabled by plumbing, pipes, and pumps).' (Anand, 2011: 545) Finding concepts of informality and legality, haves and have-nots, to be largely inadequate, Anand instead centres his analysis

on the metaphor of *pressure*, attending to how water is 'drawn into and exceeds political formations' (ibid: 544) through the everyday practices of settlers, engineers, plumbers, petitioners, and municipal officials. Noting the presence of a local resident's charity pump 'provided … for poorer households', or an entrepreneur's 'surreptitious connection to the mains', Anand traces the different practices and apparatuses that people use to 'move the water into their household storage tanks at water time.' (Anand, 2012: 493)

The challenges of leaky pipes, low pressure, and high elevation affect everyone, even as coverage fluctuates within neighbourhoods. There is water in Mumbai, but provision and access is mediated by religion, age, gender, and class. (Anand, 2012: 493) These variations reflect the water supply infrastructure's origins as a *colonial* system, a product of engineering expertise imported from the metropole. Unevenly implemented from the very start, colonial administrators and would-be system-builders faced limited resourcing from supervisors in London, who 'questioned whether the city and its subjects were deserving of the fiscal investments entailed by a modern water system' (Anand, 2017b: 14). When permissions and financing *were* secured, the system's first connections served 'the city's military cantonment and its wealthy native merchant communities.' (ibid.)

Traveling from Mumbai to Jos, a Nigerian city assailed by the intermittent, unpredictable availability of power, fuel, and water, Ulrika and Erik Trovalla describe how 'rhythms of disconnection and reconnection' become a series of signals, a puzzle to be solved. (Trovalla and Trovalla, 2015a: 332) Examining how people look to address problems, even in the absence of clear answers, the authors attend to rumours, hopes, and concerns, as 'observations are exchanged, refined and adjusted according to gradual shifts in conditions.' (ibid: 334) Responding to these vagaries of connectivity, many of Jos's inhabitants have come to rely on *multi-infrastructural assemblages*, comprising a 'superfluidity of back-ups, add-ons and parasitic or competing systems' (ibid: 335). An irregular or unreliable electricity supply might be supplemented by candles and kerosene lanterns, generators, car batteries, and solar panels. (ibid.)

In Jos, infrastructure constitutes a *palimpsest* of systems with different biographies and points of origin, an array of water pipes tracing the city's history through the strata of its evolving sociotechnical logics:

> The asbestos pipes of the 1930s outline the template of a British colonial tin-mining town founded in 1915. The galvanized iron pipes of the 1970s tell the story of great infrastructural expansion backed by strong finances. Now, PVC pipes laid by Chinese contractors grapple to encompass patches of land among the sprawling suburbs, while the

> older layers slowly decompose. (Trovalla and Trovalla, 2015b: 44)

This most recent layer is symptomatic of China's growing influence in Nigeria, with the spread of 'China quality' goods, such as household-scale generators, evoking memories of colonial times, 'when Nigeria was connected to other commodity chains, and thus to other patterns of cultural, political and economic exchange.' (Trovalla and Trovalla, 2015a: 340) These multi-infrastructural assemblages undercut Star's presumption of transparency, reflecting a 'continuum of awareness' between *infra-* and *supra-*; between relative transparency and a state of hyper-visibility, 'where systems are highly present in people's minds' (Trovalla and Trovalla, 2015b: 54).

Taken together, the work of these authors demonstrates the breadth of this anthropological research on infrastructure. In their respective research trajectories, an ethnographic attention to Chinese-made diesel generators or variations in 'pressure' proves more generative than further reifying hardened categories of formality and informality. Next, I turn to STS ethnographers Casper Bruun Jensen and Atsuro Morita, who approach infrastructures as *ontological experiments*.

Although infrastructures are 'largely seen as *designed* and *planned* technical systems' (Jensen and Morita, 2015: 82), complexity is always in the background; an inescapable by-product of their networked structure, and a source of unpredictability, emergence, and failure. For Jensen and Morita, infrastructures simultaneously 'integrate a multiplicity of disjunctive elements and spin out new relations between them' (Jensen and Morita, 2017: 617). They invite us to consider a building's pipework: coordinating water flows across radiators, toilets and baths, 'it makes up (part of) a material world in and through which people live; one with which they might, of course, in turn, tinker, and interfere.' (ibid: 619)

Stressing the open-ended nature of these ontological experiments, Jensen and Morita advocate a symmetrical approach to the involvement of diverse entities, human and non-human alike, such that:

> the fact that designers turn eco-homes, sewage systems or irrigation channels into infrastructural test-sites … is neither more nor less consequential than the fact that other people, not to mention bacteria, sludge, long-stemmed rice or spirits, engage with and transform those sites in turn. Intended designs and unintended responses all happen on the same "plane." All involved entities play roles, large or small, intended or otherwise, in the ongoing transformation of the plane itself. (Jensen and Morita, 2015: 84)

This is a radically different approach to that offered by more heroic accounts of infrastructural and urban development, many of which emphasise the enduring influence

of so-called 'system builders', innovators, and entrepreneurs.

Bringing the concept of the *ontological experiment* to bear on his own empirical work on sewage infrastructure in Phnom Penh, Cambodia, Jensen (2015; 2017a; 2017b) describes sinkholes and flooding as ruptures foregrounding the 'infrastructural work done by ... trees, bacteria, sludge, water plants, and cockroaches.' (Jensen, 2017a: 227-228) From this standpoint, the sewage system's features are 'multiple, spanning sludge, the southern slope of Phnom Penh, the cost of pipes, collaborations between international organizations, climate change, demographic reconfigurations and much else.' (Jensen, 2017b: 637) Suitably sensitised, there may be greater value in apprehending infrastructures as 'events rather than as stable structures, … assemblages where multiple forms of agency and activity condense, but also where actors are given new form.' (ibid: 629-630)

In this section, I have provided an overview of a distinctively ethnographic approach to the study of infrastructure, describing how an emphasis on ethnographic thick description and the mobilisation concepts from anthropology and STS has challenged a once-dominant interpretation of infrastructure as purely *technical systems*.

2.3. Sociotechnical change

Moving from infrastructure to sociotechnical change, this section introduces three theoretical approaches with salience to this study; the multi-level perspective on sociotechnical transitions (MLP); large technical systems (LTS); and the social construction of technology (SCOT). Although these approaches differ in focus and units of analysis, they all challenge linear models of technological development, having emerged from a constructivist tradition predicated on a recognition that 'things could have been otherwise.' (Bijker, 1997: 280) They also share an emphasis on structure and the stabilisation of technology, making them well-suited to a study of urban infrastructure and patterns of change.

Why 'sociotechnical'? Throughout this study, I follow Thomas P. Hughes (1983; 1986) in noting how 'hard, analytical categories' (Hughes, 1986: 285) such as technology, science, politics, economics, and the social, have proven ineffective in accounting for the development and spread of infrastructural forms. Responding to these limits, Hughes used 'sociotechnical system' to reflect incorporation of social organisations within

technoscientific systems. (ibid: 290) For me, the 'sociotechnical' operates as a heuristic; a means to sensitise and slow those researchers who would enter the field or the archive looking for 'discrete entities rather than seamless webs, particles rather than waves.' (ibid: 291)

2.3.a. Sociotechnical transitions

Work on *sociotechnical transitions* represents the outcome of a slow, piecemeal integration of a several research currents adopting a 'systemic view of far-reaching transformation processes of socio-technical systems.' (Markard et al., 2012: 956) These included a practice- and policy-focused approach to transition management, work on 'technological innovation systems', strategic niches, and a multi-level perspective on sociotechnical transitions (MLP). In the past 15 years, these conceptual approaches have locked together to form an integrated approach to sociotechnical transitions, mobilised as a foundation for a wide spread of research on patterns of continuity and change.

Within this multi-level approach, 'transition' denotes a far-reaching shift in a sociotechnical system, from one stable state to another; with associated changes across technological, material, organisational, institutional, political, economic, and socio-cultural dimensions. (Markard et al., 2012: 956) Often taking upwards of 50 years, and involving a range of actors, transitions encompass multiple technical and non-technical developments, and usually see the emergence of 'new products, services, business models, and organizations', and 'changes in user practices and institutional structures' (ibid.). Applying a transitions framework to historical cases, Frank Geels has described the shift from sailing ships to steamships (2002), the replacement of horse-based transport with the automobile (Geels, 2005), and the breakthrough of rock and roll in the post-war United States. (Geels, 2007)

The multi-level perspective proceeds from the claim that sociotechnical change occurs through interactions among three nested levels: niche, regime, and landscape. (Sovacool and Hess, 2017: 709) A *niche* is a protected space supporting the development of radical, 'path-breaking' innovations through experimentation and social learning. (Smith and Raven, 2012: 1025) The *regime* comprises a more-or-less stable configuration of 'technology, user practices and application domains (markets), symbolic meaning of technology, infrastructure, industry structure, policy and techno-scientific knowledge.'

(Geels, 2002: 1262) Finally, the wider *landscape* stands as the domain of slow-moving 'exogenous developments or shocks that create pressures on the regime', such as demographic patterns, or environmental change. (Sovacool and Hess, 2017: 709) A successful transition unfolds through the interaction of these different 'levels.' Small networks of actors support radical innovations, which accrue incremental improvements as they are extended to additional domains of application, while landscape-level developments may, over time, present opportunities for a new configuration.

The allure and outsized influence of the MLP has been widely recognised, with even its critics conceding its parsimony and the apparent strengths of its conceptual repertoire. (cf. Smith et al., 2010: 442) Responding to a critique of the framework as unfalsifiable, privileging the 'choices and worldviews of the (not necessarily self-critical) analyst' (Genus and Coles, 2008: 1442), Geels reaffirms the MLP's status as a *heuristic* device; a means for tracing 'event sequences and the conjunctures within and between levels.' (Geels, 2011: 35)

2.3.b. Large technical systems

Derived, initially, from a comparative history of power networks and electrification in Berlin, London, and Chicago (Hughes, 1983), the *large technical systems* (LTS) approach assumes a system of sufficient size constitutes 'a historically and sociologically … important category of phenomena' (Van der Vleuten, 2004: 399), set apart by its. Set apart by its scale and complexity, the LTS approach asserts that a national-scale electrical grid has more in common with a comparably sized water or gas distribution network than an electrical system of more limited scope.

But what is a large technical system? Where do we draw the line? Bernward Joerges argues the term should be limited to 'heterogeneous systems of physical structures and complex machineries which (1) are materially integrated, or "coupled" over large spans of space and time, … and (2) support or sustain the functioning of very large number of other technical systems' (Joerges, 1988: 24). Lena Ewertsson and Lars Ingelstam extend on this definition, fleshing out the description of a system encompassing 'material *technology components*, a particular kind of *flow*, *individuals* and *organizations* that develop, use, govern and control the system, as well as *institutional elements* … which embody *cultural values* and *professional know-how*, and *users* of the system.' (Ewertsson and Ingelstam,

2005: 293) Reading across these two definitions, we can see how the LTS approach encompasses not just infrastructure systems, but can also account for the workings of such 'modern heterogeneous systems of technology' as airlines, air traffic control, nuclear power, space systems, and district heating. (ibid.)

Having offered a preliminary definition of large technical systems, I want to highlight four concepts from the LTS literature with relevance for this study: *momentum*, *system builders*, and *technological style.* Of these, the most important is *momentum*. Envisaged as 'analogous to the inertia of directed motion' (Ewertsson and Ingelstam, 2005: 295), momentum brings together notions of mass, velocity, and apparent goal-directedness. (Joerges, 1988: 14) A source of 'soft determinism' (Hughes, 1987: 55), it gives large technical systems an appearance of 'autonomy' or their own agency. By centring momentum in analysis, the concept can 'prevent social science research on LTS [from taking] these appearances at face value' (Joerges, 1988: 14). Momentum also 'points forcefully to the impact of the past on the future direction of a system' (Ewertsson and Ingelstam, 2005: 295), wherein a given system acquires its own trajectory. A system with well-developed momentum may resist attempts at redirection, steering, or change.

Embracing an explicitly 'heroic' model of system development at odds with, say, some of the more relational approaches to infrastructure and sociotechnical change, LTS emphasises the determining role of individuals and small groups, acting as initiators and architects. Such *system builders* are 'privileged actors who manipulate and juxtapose 'heterogeneous' elements' (Van der Vleuten, 2004: 399), to 'develop, support and sustain' given systems. (Ewertsson and Ingelstam, 2005: 296). Whether individual or institution, they are 'capable not only of producing ground-breaking inventions, but also imagining and bringing into being the large ensembles … needed to support and sustain them.' (Jackson et al., 2007)

Finally, *technological style* is a concept used to emphasise the fact that technical systems are 'subject to variations, characterized by specific contextual and circumstantial factors.' (Ewertsson and Ingelstam, 2005: 297) As Hughes recognises, questions of *style* assume greater weight in a world where 'international pools of technology are available to the designers of regional technology because of … the migration of experts, technology transfer agreements, and other modes of exchange of knowledge and artifacts.' (Hughes, 1987: 69) In this, 'difficulties often arise in transfer at another time or to a different environment' (ibid: 67), with successful transplantation usually requiring adaptation,

translation, and a sensitivity to the demands of a different setting.

2.3.c. Social construction of technology

The *social construction of technology* (SCOT) represents an attempt to extend and apply constructivist approaches from the sociology of science to the analysis of technological artifacts. SCOT starts with the assumption that the 'developmental process of a technological artefact is … an alternation of variation and selection.' (Pinch and Bijker, 1984: 411) An initial design, or prototype, births a wide range of variants, some of which 'die' while others 'survive.' In describing this developmental process, SCOT deploys four main conceptual elements: *interpretive flexibility*, *relevant social groups, closure and stabilisation*—encompassing discussions of *closed-in* and *closed-out* forms of stability—and *technological frames*.

Trevor Pinch and Wiebe Bijker (1984) use *interpretive flexibility* to suggest an openness in early interpretations of technological artifacts. In the early stages of development, there may be limited consensus on the essential features of a given technology, such that, whatever the outcome of the selection process, things could have been otherwise. Taking this level of flexibility as a point of departure, SCOT approaches account for how *relevant social groups* influence technologies' form and meaning. Taking the case of the bicycle, a SCOT approach flags the role of bicycle users, but also the influence of 'anti-cyclist' agitators, and identify a need to differentiate between women cyclists and sportsmen. (1984: 414) With distinct interests and requirements, these different groups each advocated for their own interpretation of the technology, with the interplay of their conflicting aims and preferences shaping its development trajectory.

For SCOT, the interpretive flexibility of technology implies that 'invention' is not an event, but instead denotes the sustained 'stabilization of an artefact amongst more than one group' (Pinch and Bijker, 1984: 424) as interpretive flexibility diminishes and meanings converge. This is a process that relies on *closure mechanisms*, such as 'rhetorical closure', a declaration that relevant groups' outstanding problems have been solved, or 'closure by redefinition of the problem', wherein unresolved issues are sidelined as actors work to shift focus elsewhere. Finally, the *technological frame* explains how 'the sociocultural and political situation of a social group shapes its norms and values, which in turn influence the meaning given to an artefact' (ibid, 1984: 428). Technological frames

mediate between relevant groups, allowing existing practice to guide future developments through a kind of feedback loop: 'artefact–technological frame–relevant social group–new artefact–new technological frame–new relevant social group, etc.' (Bijker, 2010: 69)

With a given technology's durability standing as a product of closure, it is important to differentiate between *closed-in* and *closed-out* forms of hardness. *Closed-in* hardness describes how actors with a high level of inclusion in the technological frame come to see everything through the lens of the relevant technology, restricting the uptake of alternatives, as in the use of automobile technology by the inhabitants of Los Angeles. (Bijker, 2010: 70) *Closed-out* hardness, on the other hand, is experienced by those with low levels of inclusion in the frame, who lack the literacy to change or modify the functions of a given technology. As one example, Bijker points to the standardisation of mains power voltage and wall plugs, which allow little room for 'differentiation by tinkering with transformers and plugs but complete acceptance by buying the right plug and apparatus, or by not using electricity at all.' (ibid.)

In this section, I reviewed three theoretical accounts of sociotechnical change: the multi-level perspective on sociotechnical transitions (MLP), work on large technical systems (LTS), and, lastly, the social construction of technology (SCOT). These approaches differ in their units of analysis (regime, system, artifact) and the relative emphasis they place on meaning and agency, but they share a common focus on structure and the stabilisation of technology. Seeing technology and society as co-constructed, they are well placed to 'address the analytical tension between the reproduction of current systems and normal ways of life ('stability') and the emergence of alternatives that can form the seeds for transition ('change').' (Sovacool and Hess, 2017: 733)

2.4. Urban technology and the built environment

In extending the above work on infrastructure and sociotechnical change to an urban setting, my starting point is Eduardo Aibar and Wiebe Bijker's memorable classification of the city as an 'enormous artifact' (Aibar and Bijker, 1997: 23); a description which troubles received categories of the urban and the technological. In this section, I follow Anique Hommels in approaching the urban as another manifestation of that 'seamless web' of the social and the technical, rendering the city and its built environment amenable to the 'same conceptual tools that are applied to other technologies, such as bicycles, transport systems and refrigerators' (Hommels, 2005: 21).

This is something with a growing presence in STS, as demonstrated by the decision to include a dedicated chapter on 'STS in the City' in the fourth edition of *The Handbook of Science and Technology Studies.* In this 2017 contribution, Ignacio Farías and Anders Blok describe two emerging currents of research; one that treats the city as a setting for exploring the workings of science and technology, and another which applies the conceptual repertoires of STS to urban phenomena *beyond* science and technology. (Farías and Blok, 2017: 555)

Sensitive to both approaches, but aligning this study more closely with the latter, I begin by looking at three 'grand plans', examples of historical efforts to fundamentally reshape existing cities, demonstrating the role of material resistance in urban authorities' attempts to direct and shape the trajectory of sociotechnical change, before turning to Graham and Marvin's influential 2001 text, *Splintering Urbanism*—paying particular attention to their work on the 'modern infrastructural ideal' (Graham and Marvin, 2001).

2.4.a. Grand plans

The description with which I opened this section, casting the city as 'an enormous artifact' (Aibar and Bijker, 1997: 23), is drawn from a 1997 study of Catalan civil engineer Ildefons Cerdà's 1855 *Eixample*; a plan for the extension and redevelopment of Barcelona. With high walls imposed on the city by Philip V of Spain in 1714, and construction prohibited outside this 'rigid straitjacket of stone' (ibid: 4), by the mid-nineteenth century, Barcelona's population density was amongst the highest in Europe. Using SCOT to analyse the controversy around Cerdà's plan, they identify three relevant social groups*: engineers, architects, and an emerging working class movement*. Associated with the interests of an emerging bourgeoisie, the engineers' frame was relatively progressive, emphasising hygiene, mobility, and economic growth. The city's architects, by comparison, adopted a frame that favoured the preservation of private property and reinforced a clear distinction between the urban centre and its periphery. Denied representation, a radicalised working class came to interpret the extension 'not only as a clear attempt to build an exclusive residential area for the upper classes but also as a direct bourgeois attack on the proletarian city in the old Barcelona.' (ibid: 15)

With these different groups using the *Eixample* to assert their respective identities and realise long-held goals, in ways that often conflicted, closure was only achieved

through compromise. (Aibar and Bijker, 1997: 12) Cerdà's block layout was approved in an 1860 Royal Decree, but his economic plans and proposed building regulations were ignored. (ibid.) As implementation dragged on, he made a number of concessions to his opponents, reducing street width and jettisoning plans for worker housing. (ibid.) Even the smallest technical details of the *Eixample* embodied a particular politics, such that a 'few meters added to or subtracted from the width of streets could … mean a lot for the power relations between the property owners, the city council, and Cerdà.' (ibid: 21)

Following this account of Cerdà's attempt to expand Barcelona, I turn to Paris, where a broadly comparable set of urban renovations, commissioned by Napoleon III, were unfolding in parallel. Implemented by Georges-Eugène Haussmann between 1853-70, this renewal programme included the clearance of overcrowded medieval neighbourhoods, the construction of new avenues, parks, and squares, the installation of a new sewer system, and, in 1860, the annexation of eleven suburban communes bordering the city. In this reworking of Paris, as architectural historian Spiro Kostof notes, 'heralded a technologically minded, comprehensive approach to town planning' (Kostof, 1994: 11). However, the enduring image of Haussmann as a system-builder and harbinger of French urban modernity elides the work undertaken by his predecessor, Rambuteau, his application of earlier established ideas, the uneven spatiality of his interventions, and the fact that redevelopment continued into the 1920s, some fifty years after his removal from office. (Soppelsa, 2009)

The third of these 'grand plans' addresses the city planner Robert Moses' influence on the shape of twentieth-century New York. Today, Moses's work is most often cited in the context of his decades-long struggle with author and activist Jane Jacobs. Starting in Long Island, Moses 'knit his spider's web of roads nearer the heart of the city, bulldozing increasingly dense urban fabric and eventually setting his sights of Washington Square Park, the historic centre of Greenwich Village.' (Paletta, 2016) Hearing of Moses's plan to extend Manhattan's 5th Avenue through the park, an alarmed Jacobs tapped into rising public disillusionment, mobilising opposition, and ultimately forcing the city to cancel the planned redevelopment. This fight was repeated in his attempted implementation of the Lower Manhattan Expressway, with Jacobs' coalition fighting the city on a plan to extend Interstate 78 through the densely settled neighbourhoods of SoHo and Little Italy.

Within STS, however, a different element of Moses's work has attracted attention. Drawing from Robert Caro's monumental biography of Moses, *The Power Broker* (1975),

Langdon Winner cites the 'extraordinarily low' overpasses spanning the Moses-constructed parkways of Long Island as evidence that technological artifacts *embody*, rather than simply reflecting, particular power relations. (Winner, 1980: 123) Moses's low-spanning overpasses reflected his social-class bias and racial prejudice, allowing the passage of automobile-owning whites, but blocking twelve-foot-tall city buses, and, consequently, their typically low-income and African American passengers, from accessing Jones Beach, a popular public park. Outliving their architect, the bridges embodied 'a systematic social inequality', constituting 'a way of engineering relationships among people that, after a time, becomes just another part of the landscape.' (Winner, 1980: 124)

But the story does not end there. Revisiting the argument in 1999, Bernward Joerges traced Winner's account back to *The Power Broker*, where it was substantiated by interviews with an engineer and a regional planner. With no earlier sources, Joerges concludes that, regardless of the bridge's effects, 'such an intention never existed.' (Joerges, 1999: 416) Offering one further twist in the account, Steve Woolgar and Geoff Cooper describe how the foundation of the story was called into question by one of their students, who said she rode the buses on the parkways with some regularity, casting doubt on the example's 'basic material premise' (Woolgar and Cooper, 1999: 434). Substantiating this objection, they reproduce a copy of the MTA timetable for the Jones Beach Bus, concluding 'the bridges did not prevent buses travelling down the parkways on Long Island.' (ibid: 435)

Although *these particular bridges* do not embody a racist or discriminatory politics in the way Winner claimed, historical evidence supports the claim that Moses contributed to structural racism, supporting and implementing 'policies he took to be liberal, reformist and above all progressive … [but] which left existing race and class relations unaffected' (Joerges, 1999: 418). In this, his plans to facilitate automotive mobility and economic growth through the extension of 5th Avenue and the Lower Manhattan Expressway, while stymied by Jacobs, are better, or at least, more *systemic* icons of the embedding of discriminatory power relations than any parkway overpass.

Although these grand, totalising plans of Cerdà, Haussmann, and Moses presumed an 'almost infinite malleability of the existing urban configuration' (Hommels, 2005: 323), each had to contend with obstacles and opponents, overcoming the *obduracy* of existing urban structures to make a lasting impact on the shape of their respective cities. Though each benefited from political support and extensive funding, they stand as the urban

equivalent of Hughes' *system builders*, striving to realise a 'modern infrastructural ideal.' (Graham and Marvin, 2001)

2.4.b. The modern infrastructural ideal

To understand this so-called 'modern infrastructural ideal', we first must engage with the central argument of Graham and Marvin's 2001 book, *Splintering Urbanism*. Like the constructivists, Graham and Marvin also start with the idea of modern cities as 'sophisticated technological artefacts', of which infrastructure networks are the most important constituent part. (Graham and Marvin, 2001: 10) With this as their foundation, they present an account of the fragmentation of the territorially cohesive city, describing a situation where 'physically close spaces can, in effect, be relationally severed' (ibid.). This undermines the idea of infrastructure as substrate or connective tissue, challenging perceptions of the city as a singular, clearly delineated entity, and forcing us to rethink questions of space and scale. (ibid: 16)

What has been lost in this fragmentation, they argue, is the modern infrastructural ideal—the 'ideal of *rolling out* monopolistic, standardised and integrated infrastructure networks to cover a city, region or country' (Graham and Marvin, 2001: 426). This ideal constituted four 'pillars':

> (1) 'progressive', technoscientific ideologies, pursuing modernisation 'through standardised infrastructure monopolies';
>
> (2) urban planning, and the new discipline's vision of a unitary city;
>
> (3) Fordist mass production and 'wider practices of home-based consumption, mediated by energy, water, transport and communications grids'; and
>
> (4) the buy-in of modern cities and nation-states, committing to 'providing public infrastructure monopolies within their respective territories.' (ibid: 43)

Considering the subjects and setting of my own research, I am particularly interested in how Graham and Marvin account for the diffusion and translation of this modern ideal to the postcolonial cities of the global south, examining how unequal power relations shaped the style of urban infrastructure provision, and the role of this ideal in the developmental agendas of colonial and postcolonial states. (Graham and Marvin, 2001: 81)

Examining the role of the modern ideal in colonialism, Graham and Marvin trace the emergence, first, of a networked urban core, inhabited by metropolitan and local elites, and, second, economic enclaves and trading posts, linked by 'rail and seaports, and international and regional telegraph and telephone cables' so as to 'incorporate local production processes, resources and labour into an economic system under strong external influence.' (ibid: 83) The creation of those 'well serviced urban cores' (ibid: 82) demanded levels of infrastructure investment beyond that required for the extraction and transport of resources. With limited investment for improvements, the colonial city experienced discontinuities in urbanisation, such that the 'physical environment, services, income, cultural values and institutional systems … vary markedly … from street to street.'[12] (Balbo, 1993: 24)

Tracing the fate of the infrastructural ideal, Graham and Marvin shift their focus to a 'contemporary shift towards [its] wholesale and widespread unravelling' (Graham and Marvin, 2001: 88), a process they dub *splintering urbanism*. Although their thesis is compelling, it has also attracted a great deal of criticism. A first line of critique is levelled by Coutard and Guy, who attack the argument as an overly pessimistic form of 'soft determinism'. They contend that the social meanings and effects of technological systems are more ambivalent and contingent than the splintering urbanism thesis acknowledges. (Coutard and Guy, 2007: 718, 720) Calling for researchers to balance stories of domination with cases of adaptation, contestation, and resistance, they advocate for a more 'hopeful' research practice, capable of posing 'evaluating questions about how urban technologies are socially appropriated, why and in whose favour?' (ibid: 731)

A second line of criticism argues that, in authoring an account based on abstraction and generalisation, Graham and Marvin paid insufficient attention to the modern infrastructural ideal's status as an ideal; always more of an imagined archetype, a projection or performance, than an existing form. Coutard argues that Graham and Marvin's claims around the unravelling ideal neglects the fact that 'many cities in lower-income countries are not *splintering*, [but] are and have long been *splintered*' (Coutard, 2008: 1816). As such, the collapse or unravelling or the ideal is not the result of exogenous pressures on integrated infrastructure networks, but the consequence of a gulf between

[12] My field site of Ahmedabad diverges from this model; although the British East India Company maintained a presence in the city from the early seventeenth century, the city's lack of natural resources and established position as a centre of trade enabled local elites to maintain a level of autonomy, remaining, for the most part, in the historic walled city, while the British established a military cantonment to the north; see Chapter 4, pp. 68–69.

rhetoric and reality, and the ideal's 'historical failure … to fulfil its promise' (ibid: 1817).

2.4.c. Beyond the modern infrastructural ideal

Responding to Graham and Marvin, Kathryn Furlong explicitly works to move discussion beyond the modern infrastructural ideal, arguing that theories of urban infrastructure would be strengthened by a deeper 'engagement with coexistence between —as opposed to the uniformity of—sociotechnical systems.' (Furlong, 2014: 140) While work on LTS, sociotechnical transitions, and splintering urbanism have all contributed to our understanding of infrastructure, she argues, they have positioned post-war, western systems as the 'apex of infrastructural development', conflating 'system' with uniformity, and 'transition' with displacement. (ibid.)

Taking the case of water supply, Furlong says that there are good reasons for 'fostering coexistence among … systems', in many situations, a preferable outcome to the top-down imposition of a uniform, 'black-boxed' network. (Furlong, 2014: 141) Generalising from her own work in urban Colombia, she cites the example of rainwater harvesting, used in combination with piped water to cut household bills, maintain user independence, and relieve demand on water treatment capacity—enabling better use of a limited piped supply. In a situation where we cannot presume the linear displacement of one system by another, many theories pay insufficient attention to the activities of *users*, disregarding the importance of *incremental* change. Furlong argues Southern infrastructural contexts would be better served by a less heroic and economistic body of theory, where 'durability'—and, by implication, 'dominance'—are a product of sustained and integrated network linkages, rather than size or complexity. (ibid: 144)

One possible response to Furlong's call be seen in the work of Mary Lawhon and her colleagues; specifically, their idea of the 'heterogeneous infrastructure configuration' (Lawhon et al., 2017). The heterogeneous infrastructure configuration builds on an earlier, 'situated' outgrowth of urban political ecology (UPE), which sought to extend and strengthen UPE's historical-materialist approach. (Lawhon et al., 2014) Critiquing the homogeneity of much work operating under the UPE banner, they investigated the possibilities for a more pluralistic disposition, invoking Dipesh Chakrabarty (2000) to speak of *provincialising* UPE; developing a 'framing that is more attentive to place and that can question taken-for-granted ideas in order to broaden the scope of theorizing' (Lawhon

et al., 2014: 505). The result was a *situated* urban political ecology, concerned with everyday practices, but with an eye on possibilities for indirect confrontation and incremental change.

As an attempt to further extend and mobilise this situated UPE, the heterogeneous infrastructure configuration also starts with the everyday, centring the ways in which urban inhabitants already use multiple infrastructures in their daily lives. Attending to Trovalla and Trovalla's ethnographic work in the Nigerian city of Jos (2005a, 2005b) or Furlong's own studies of water supply in Quibdó and Medellín (2013, 2014, 2016), gives a sense of how the heterogeneous infrastructure configuration might offer a greater appreciation of the role of infrastructural artifacts in spatially-distributed configurations involving 'many different technologies, relations, capacities and operations' (Lawhon et al., 2017: 722).

Moving beyond debates over state, community, or private ownership (Lawhon et al., 2017: 722), this work avoids, where possible, clear-cut categorisations of 'formal' and 'informal' systems, circumventing a monocular focus on the expectations and failings of the modern ideal. As heterogeneous configurations, these web-like entities exhibit great diversity, disrupting and decentring assumptions about 'ordered exchanges between different … 'sub-systems'' (Lawhon et al., 2017: 725) and the balance of durability and precarity. As a way of foregrounding relational materialities and the influence of the surrounding landscape, thinking through heterogenous infrastructure configurations:

> pushes us beyond analysing any specific innovation or intervention into seeing the relationships between these different efforts, and the ways in which they complement and conflict with each other. (ibid: 730)

Though tracing the contours of a particular such configuration can offer ever only a *partial* explanation of the success or failure of infrastructure projects—as other, influential entities remain off-stage, stubbornly opaque—a tightly focused user's-eye view may offer the most *faithful* account of infrastructure's role in daily life, picking up details and relations inaccessible by other means.[13] Equally importantly, for Lawhon and her colleagues, such an approach allows us to ask where and how infrastructural changes create opportunities for 'more just and sustainable urban conditions.' (ibid: 722)

For all its incompleteness and unravellings, the modern infrastructural ideal nonetheless continues to exert a powerful symbolic and rhetorical pull. Though Graham

[13] Compare with Zeitlyn (2009) on faithfulness as a criterion of interpretive research; on knowledge production in sociotechnical *flânerie*, see Chapter 5, pp. 81–83.

and Marvin's splintering urbanism thesis is insensitive to the *difference* of infrastructural forms that exceed or transgress the landscapes depicted in those accounts of the master planners of Barcelona, Paris and New York, the ideal of territorially-integrated public monopolies remains a lurking presence, striating and funnelling investment and attention.

2.5. Urban laboratories and ontological experiments

In the final part of this chapter, I address a cluster of literature on the 'urban laboratory,' which approaches urban sociotechnical change through the figure of the experiment. In addressing this work, I hope to flesh out a more explicitly *relational* approach to the urban, a set of concepts that can extend and accommodate postcolonial responses to the modern infrastructural ideal.

Though the notion of the 'urban laboratory' has seen rapid uptake, 'striking a chord with actors involved in urban change' (Karvonen and van Heur, 2014: 380), its diverse manifestations and substantial interpretive flexibility can leave the onlooker perplexed. Asking what a 'new-old terminology' of laboratories and experimentation can contribute to work on urban change, Andrew Karvonen and Bas van Heur align themselves with existing work in the laboratory studies tradition. (ibid: 385) Focusing on the distinctiveness of experimentation as a form of knowledge production, they argue, highlights urban laboratories' emphasis on *situatedness*, *change-orientation*, and *contingency*. Taking these three achievements as benchmarks, 'we can then evaluate and critique those practices that claim to be urban laboratories. (ibid: 381) Lamenting a tendency by other actors and researchers to conflate 'experimentation' with change, they argue that it should be limited to those cases '(1) involving a specific set-up of instruments and people that (2) aims for the controlled inducement of changes and (3) the measurement of these changes.' (ibid: 383)

If it is to be meaningful, the urban laboratory is best approached as a particular form of experimentation; a 'profoundly localized' configuration of entities and elements that produces 'non-local concepts and theories' (Karvonen and van Heur, 2014: 383, 384). Although many actors may adopt a lexicon of laboratories and experiments as a way to stake a claim on the legitimacy and authority of 'scientific' knowledge, efforts to translate and emulate scientific practices may nonetheless have substantive effects; engaging publics, enlisting support, and contributing to the production of new meanings. (ibid: 382)

Karvonen and van Heur note how the 'urban laboratory' label legitimises experimental practices 'within prescribed boundaries', typically selected for their 'opportunities for success' or a 'desperate need for different conditions.' (ibid: 386, 387) In contrast with their scientific antecedents, such spaces have an acknowledged open-endedness, with participating actors 'embracing the complexity and fluidity of urban change processes' (ibid: 388). Characterised by their *situatedness*, explicit *change-orientation*, and openness to *contingency* and unaticipated outcomes, such urban laboratories and experiments thus constitute 'intentional sites of urban innovation' (ibid.).

In a later paper, Federico Caprotti and Robert Cowley sound a note of caution, calling for greater focus on the *normativity* of narratives of urban change. In the rapid uptake of 'discourses of experimentation', they see actors subscribing to a view of the urban as a problem, 'to be solved through sociotechnical means.' (Caprotti and Cowley, 2017: 1441) Moreover, they argue, there is a palpable amnesia in accounts and discourses of urban laboratories, a collective forgetting of the times 'often within living history, when societal and urban experiments have moved from utopian intent to dystopian or authoritarian reality.' (ibid: 1446) There is more than a little of those modernist grand plans, here, with echoes of the laboratory in the slum clearances of Haussmman's Paris and Moses's New York. This is a tendency we can see today, in new urban forms legitimised by urgency—refugee and internment camps, gated communities, charter cities, smart cities, and special economic zones. Whatever the normative orientation of transitions as a field of research, 'bounded sociotechnical experiments are not all aimed at socio-environmental and technical-economic "progress", nor do they all have progressive outlines—or consequences.' (ibid: 1447)

As one example, urban infrastructure scholar Govind Gopakumar brings this 'laboratory' lexicon to bear on a pilot public-private partnership operating in an informal settlement in Bengaluru, a setting 'marked by a high degree of social and spatial fragmentation' (Gopakumar, 2014: 394). Arguing that the transition from state provision to a commercial, privatised water system provided an opportunity for 'institutional experimentation', and casing water-supply partnerships as 'interactive urban laboratories', Gopakumar emphasises how such ventures replaced existing 'artisanal, social relations of water provision' with 'standardized, commercially managed … connections.' (ibid: 395, 400) Applying Karvonen and van Heur's criteria for evaluating urban laboratories, he describes how this partnership expanded a patchy 'archipelago' of water coverage, 'transforming slum residents into regular customers' (ibid: 409), even as

slum dwellers and an NGO tried to 'exert community control over water provision.' (ibid: 408) In the interplay of these different actors' experiments and counter-experiments, the public-private partnership acquired new territories, even as it remained vulnerable to 'tendrils of 'unauthorized' taps and standpipes' (ibid: 409). Unable to 'fix' its objectives and consolidate control, all parties remained 'painfully aware' of the partnership effort's 'tenuous and contingent nature' (ibid.).

Describing an experimental, open-ended partnership seeking to expand an archipelago of networked supply, and create paying customers, within Bengaluru's slums, Gopakumar's paper highlights resonances between the literature of urban laboratories and ethnographic work on infrastructures as 'ontological experiments' (Jensen and Morita, 2015; 2017), introduced earlier in the chapter. These two, relatively minor bodies of work have much in common, with urban laboratories constituting a *deliberate* attempt to engender ontological experiments of the type described by Jensen and Morita. In this, Karvonen and van Heur's emphasis on contingency and open-endedness provides a useful hinge, mirroring Jensen and Morita's claim that 'infrastructural configurations are liable to unpredictable change'—not only in terms of their components and functionality, but also in the politics, society, and environment such systems generate. (Jensen and Morita, 2015: 83)

In seeking to bridge literatures on urban laboratories and infrastructures as ontological experiments, I return to Lawhon and her colleagues' notion of the heterogeneous infrastructure configuration, and their broader articulation of the value of 'situated' urban political ecology. While these three approaches differ in some ways, particularly in their accounts of power, their common emphasis on situatedness, contingency, multiplicity, distributed agency, and open-ended experimentation offers a distinct account of sociotechnical change—diverging from, say, the constructivist approaches of STS.

2.6. Discussion

This chapter situated my study in a particular disciplinary and theoretical context, summarising existing research and identifying gaps in the existing literature. I started by tracing the trajectory of ethnographic studies of infrastructure, working to foreground tensions and disagreement over claims as to the *a priori* invisibility of infrastructure

systems (after Star, 1999), and the claims of a newer, ontologically oriented body of work that has interpreted infrastructures as 'ontological experiments', demonstrating open-endedness, unpredictability, and world-making capabilities. (Jensen and Morita, 2013; 2015) Moving on to the question of sociotechnical change, I summarised three connected bodies of work that have emerged from a constructivist STS tradition: the multi-level perspective on sociotechnical transitions (MLP-SNP), a body of historically derived work characterising the development and growth of large technical systems (LTS), and an account of the social construction of technology (SCOT).

In seeking to extend theoretical frameworks more typically applied to technological artifacts and scientific practices to studies of the city, I started by exploring historical cases of attempts to enact change through top-down forms of urban planning and development. I then turned to the 'splintering urbanism' thesis, which offers an account of the fragmentation, commodification, and privatisation of urban systems, widely portrayed as undercutting an aspirational modern infrastructural ideal. (Graham and Marvin, 2001) Tracing critiques portraying this account as variously dystopian, placeless, or blind to the already uneven and partial implementation of infrastructural systems outside the West, I found studies looking to make sense of infrastructure without treating said ideal as an index or benchmark, either by stressing the interactions of coexisting systems in a multi-infrastructural context, or by attending to users' creative, effortful assembly of heterogeneous infrastructure configurations.

In the final section, I turned to work on the recent uptake of a lexicon of 'urban laboratories' and experimentation, asking what, if anything, distinguishes these new practices from existing forms of urban development. Noting that while many invocations of such language constitute actors' cynical politicking or attempts to clothe themselves in the legitimacy of dominant scientific forms of knowledge production, these so-called 'laboratories' are distinguished by their *situatedness*, *change orientation*, and necessary openness—or, one might say, vulnerability—to *contingency* and the unexpected. (Karvonen and van Heur, 2012) Lastly, I explored some possible parallels and resonances between work treating infrastructures as ontological experiments, the notion of the heterogeneous infrastructure configuration (Lawhon et al., 2017), and the work covered in this final section on urban laboratories and experimentation—arguing that, taken together, these approaches offer greater purchase on the workings of infrastructure and urban change in non-western settings.

To close this chapter, I turn to Farías and Blok's argument that STS scholars have, thus far, had little to contribute to analyses on the *distinctiveness* of particular cities, something that, they argue, reflects the fact that 'many have preferred to stay at home, in a Euro-American metropolis' (Farías and Blok, 2017: 575). As attentions shift to extra-Western settings, they argue, this will surely begin to change, 'opening up new challenges of how to adapt and decenter STS concepts into those globally traveling knowledges through which cities are shaped and reshaped.' (ibid.) In many ways, this describes the overarching frame and intent of this study of Ahmedabad and its wider envisaged contributions to knowledge. Having located the study in a disciplinary and theoretical landscape, the next chapter focuses on the mutability and mobility of different forms of infrastructure and urban development, introducing the conceptual toolkit by which I intend to achieve this.

Chapter 3: Mutability and mobility

3.1. Introduction

This chapter sets out to populate a conceptual toolbox with 'sensitising concepts' (Blumer, 1954) and 'middle range' theories (Merton, 2012 [1949]) capable of bridging totalising theories of infrastructure and urban sociotechnical change and the situated subjects I encountered in the field. Building on the previous chapter, I establish a framework robust enough to structure my ethnographic and observational material, while remaining sufficiently flexible to address those research questions established in the introduction. In this, I attend closely to the *mutability* and *mobility* of technological forms; taking the pairing of the two concepts, as in Bruno Latour's description of the 'immutable mobile' (1987), as a device to probe the spatiality and circulation of a range of artifacts, infrastructures, policies, and ideas.

In mapping *mutability*, I refer to existing work on fluidity and flexibility, building on the previous chapter to look more closely at contingent processes of stabilisation and closure, and the ways in which obduracy, path dependencies, and system-scale momentum can act as an obstacle to, or brake on, change. Highlighting examples of work that address the extension or modification of otherwise sclerotic technological systems, I then briefly review a more eclectic selection of work on disconnection, dormancy, and ruination. Motivated by a frustration with received models of innovation diffusion (Rogers, 1983 [1962]) and technology transfer, a subsequent section surveys work on technology and infrastructure *mobilities*—gathering writings on *translation*, the 'new mobilities paradigm', policy mobilities, and the appropriation and domestication of technology by its users.

3.2. The immutable mobile and its variants

This chapter's central plank is the 'immutable mobile', and its implied variants. First used by Bruno Latour (1987: 223-228) to describe the qualities of the *scientific fact*, the term highlighted its ability to endure, holding its shape, even as it travelled to diverse locales. Although the concept has since been widely operationalised, any attempts to extend it to technological artifacts and infrastructural systems requires thought and

sensitivity. Limiting our analysis to well-bounded, self-contained, or black-boxed technologies, it is easy to see how these might be fruitfully interpreted as immutable mobiles. The kinds of technological artifacts with which we are most familiar—such as toasters, smartphones, and SUVs—are typically 'invariant ... immutable because the different components hold each other in place' (Law and Mol, 2001: 611), but, contrasting movements of science and technology, I am reminded of the aphorism that it is easier to ship recipes than cakes or biscuits. The circulation of technologies requires a more muscular, extensive web of supporting infrastructure—cranes, insurance actuaries, cargo ships, intermodal freight containers, lorries, databases, and fulfilment centres—than that required to transplant a scientific fact between sites.

Although a reading of technological artifacts as immutable mobiles makes intuitive sense, in further extending this frame to infrastructure and other large technical systems, we are confronted with the concept's limits. Instead of seeing this as evidence of its explanatory failure, however, I suggest decentring the 'immutable mobile' as an ideal type, and attending to its implied variants—a move offering a more granular understanding of variations in the interplay of mutability and mobility. Attending to how different technological and infrastructural forms hold their shape, or fail to do so, as they move between settings, reveals how such dynamics occur simultaneously in 'physical and geographic space' and in 'some relational and possibly functional manner where it may … be imagined as a more or less stable network of associations.' (Law and Singleton, 2005: 335)

3.2.a. The carrack

Working, first, to extend the 'immutable mobile' to technological subjects, I begin by moving backwards in time, to early-modern Portugal, where John Law identifies an *exemplar* case in the early Portuguese Empire's adoption of the carrack, a new type of naval vessel with three or four masts and a broad hull. (Law, 1984; 1987) Where single-masted ships had struggled to 'operate with any degree of safety or certainty beyond European waters', the carrack was a 'structure with a larger envelope of mobility and integrity' (Law, 1984: 237). Enabling transportation and undistorted communication between Lisbon and Portugal's Indian holdings, Law describes how these vessels required fewer stops and smaller crews, expanding Portugal's 'navigational envelope' (ibid: 251) by holding their shape as 'part of a stable network.' (Law and Singleton, 2005: 335) In this,

the carrack was able to endure the 'dissociating efforts of a variety of potentially hostile forces', and, as in the case of winds that imperilled smaller, more rudimentary craft, 'use at least some of these by transforming them and associating them with the project.' (Law, 1987: 239)

As exemplified by the carrack, the immutable mobile describes an object stabilised as a technology, a '*network of elements that holds its shape as it moves*' (Law and Hetherington, 2000: 39), and so able to 'perform the same actions in different locations' (Guggenheim, 2010: 166). This sustained shape is symptomatic of the ship's simultaneous participation in *network* and conventional *Euclidean* space; such that 'the interference between the spatial systems affords the vessel its special properties.' (Law and Mol, 2001: 612) Holding steady, the carrack and other immutable mobiles are modern artifacts, 'dependent on science to invent them, metrologies to measure and standardize them, and standardized production lines to bring them into being.' (Guggenheim, 2016: 67) Stabilised and made predictable, such technologies also 'have the unique feature that they can break.' (ibid.) Prior to the standardisation of production, the sinking of a ship may well have been hailed as a disaster, an act of God, but, produced and piloted under conditions of uncertainty, it is unlikely that such would have been identified as a technical *failure*.

3.2.b. The Bush Pump

If technology is most frequently encountered as an immutable mobile, there is a useful contrast in Marianne de Laet and Annemarie Mol's paradigmatic case of the Zimbabwe Bush Pump as a 'fluid object' (de Laet and Mol, 2000: 226)—and which later interlocutors have interpreted as an exemplar 'mutable mobile.' (cf. Law and Singleton, 2005) While the Portuguese carrack was sufficiently stable to be faithfully rendered through description, de Laet and Mol must provide a biography of their case, describing its origins in the 'restyling' and improvement of 'an older manually-operated water pump ... first designed in 1933.' (de Laet and Mol, 2000: 228) With multiple different iterations of this precursor still in active use, they focus their analysis on the then-newest version, the 'B' type, which they describe as 'attractive and appealing', with 'clean hard lines' and a 'compact shape' (ibid.). In its totality, the Bush Pump comprises a pump head, base stand, and lever. Although the authors describe the various components and their couplings in some depth, they acknowledge the inadequacies of their textual description, resorting to the inclusion of a diagram—even as that neglects other, invisible components, such as the

'*hydraulic forces* that enable it to pump water out of the ground.' (ibid: 230)

What distinguishes de Laet and Mol's account of the Bush Pump from Law's carrack is its fluid, mutable character. It does not hold steady. As a mechanical artifact, 'its boundaries are vague and moving rather than being clear and fixed.' (de Laet and Mol, 2000: 225) The Bush Pump cannot break; at least, not irrevocably or in its entirety. In this much:

> the question as to whether the Bush Pump actually *works*, as technologies are supposed to, can only rarely be answered with a clear-cut 'yes' or 'no'. Instead, there are many grades and shades of 'working'; there are adaptations and variants. (ibid.)

The pump may become dirty, with an eroded seal or worn, rusty pipes, but 'spare parts are easy to come by.' (ibid: 240) This blurs the distinction between functionality and breakage, such that 'broken' turns from a 'final *state* into an intermediate *stage*.' (ibid.) Improvisation and assemblage reconfigure 'the relations that keep the pump going.' (ibid: 338) Such work contributes to the *fluidity* of the object, such that it 'flows and *gently* changes shape, bit by bit.' (Law and Singleton, 2005: 338)

The *mutable* mobile, then, labels an 'object or class of objects [that] may be understood as a set of relations that gradually shifts and adapts itself rather than one which holds itself rigid.' (ibid.) Thinking with the Zimbabwe Bush Pump, we can see how the mutable mobile troubles Law's earlier account, which, faced with the question of whether 'networks of relations hold their ... shape as they pass through geographical space' (Law and Hetherington, 2000: 39), answered in the affirmative. In extending these concepts to infrastructural systems and urban change, I follow this question with another: what would happen if we extended this line of analysis to objects and entities—technologies even—that remain *fixed* in Euclidean space?

3.2.c. How Buildings Learn

Seeking an answer to this question, I shift my attention to the mutable *immobile*, something sociologist Michael Guggenheim claims is exemplified in the building form. (Guggenheim, 2010) As a type, the building occupies a fixed address while remaining open to different uses and adaptations. Its function is to *locate* specific interactions, embodying the functional requirements of a school, nightclub, or co-working space, and providing would-be users with a location and resources. Exploring the limits of the form's mutability,

Guggenheim cites a 1992 Swiss court case, where the owners of an ex-industrial building in an area rezoned for residential occupation were prevented from inserting internal dividing walls that would have enabled the building to be used as office space. Despite the precedent of other, similar conversions, the court lacked the authority to *enforce* a change to residential use, as doing so would have required 'considerable construction expenditures' on the part of the owners. Where municipal authorities saw the building as a 'blank slate that could be used for anything and should thus be used as flats', the administrative court recognised any change of use was contingent on the 'unlikely combination of huge expenditures, an integrated concept and the cooperation of the owners.' (Guggenheim, 2010: 161)

This case shows how the building form can, at different times, demonstrate either recalcitrance or fluidity, resisting reconfiguration or changing in ways their original architects could not have foreseen. Continually modified by their users, buildings 'stabilize imperfectly' into *singularities* (Gieryn, 2002: 35), such that not two houses, schools, or galleries are ever quite the same. (Edensor, 2011: 240) As Guggenheim explains, a building is *mutable*; 'by being used in specific ways and by being locally stable and [connected] to its changing environment, it inevitably acquires a biography' (Guggenheim, 2010: 167).

Further delineating this mutability, Stewart Brand describes a building as comprising six 'shearing layers', each characterised by a different lifespan and amenability to change. The *site* denotes the building's setting and boundaries. The *structure* comprises the building's foundations and load-bearing components. The *skin* is the building's external fabric and facade. The *services* are the building's guts, comprising wiring, plumbing, sprinklers, heating, ventilation, air conditioning, and any escalators or lifts. The *space plan* is the internal layout. Finally, *stuff* comprises tenants' furniture and possessions, from white goods to pot plants. (Brand, 1994: 13)

In the case of my own residence[14], a space that would have originally been two houses, each occupied by a family of Yorkshire textile workers, part of a row terrace squatted, in its entirety, by hippies in the 1970s, is now the rented home and primary workspace of three adult tenants, in a way that could not have been anticipated by the original architects. At the time of writing, our roof titles are loose (*skin*), and we recently endured a month with an inoperable boiler (*services*), but we also have a guest bedroom (*space plan*), two separate internet connections (*services*), and a smart meter pegged to

[14] When first drafting this chapter section, in spring 2017.

our gas and electricity usage (*services*). Progressing through Brand's six layers, we move from the obdurate to the ephemeral, the greater tractability of the later layers corresponding to a faster replacement rate. While the slower layers exert a strong influence over the building's space plan and contents, they are often pressured to 'gradually integrate trends of rapid change' (Brand, 1994: 17). In this way, the building form demonstrates a certain degree of fluidity; 'the associations … shift and move, but they do so in way that also allows the *performance of continuity*.' (Law and Mol, 2001: 614)

3.2.d. Sticky infrastructure

Lastly, I turn to *infrastructure*, something Guggenheim identifies with the *immutable immobile*. 'Infrastructures', he argues, 'are technologies that are not only immobile, but also connected to literal networks of tubes or cables' (Guggenheim, 2016: 69). Noting a tendency for research on infrastructure to emphasise 'distribution and equality', Guggenheim concludes the fixity of such systems in Euclidean space necessarily stresses coverage and standardisation, such that success in achieving the latter would allow 'potentially endless extension, … inclusive to the same level of provision.' (ibid: 70) Read against the work reviewed in the previous chapter, this analysis is untenable, unquestioningly accepting the normative claims promoted, for example, as part of the modern infrastructural ideal. Though given infrastructural systems may *appear* immutable, to identify such systems as fixed forms is to echo Star (1999) and her sweeping declarations of infrastructure's invisibility.

Guggenheim's immutable immobile, here, denotes pipes and cables embedded in pre-existing sociotechnical systems, often sunken n the earth or otherwise removed from view. In this, Guggenheim embraces a vision of infrastructure as a product of progressive modernisation efforts. Approached as the material component of a process of taming and regularising an uncertain, variable natural world (cf. Bowker, 1995), modern infrastructural networks were envisaged as territorial monopolies, stabilised and sustained by state and municipal authorities. (Graham and Marvin, 2001) Things that are both immutable *and* immobile inhere to the operational environment, part of a backdrop against which technology shifts and moves. In this, the optimal infrastructures would be black-boxed entities, buried beneath the streets, their workings and interfaces concealed in locked cabinets, or up poles.

Such classifications, I suggest, conceal infrastructure's *stickiness*. Following development scholar Tom Scott-Smith, a consideration of stickiness reminds us that 'fluidity can come in degrees.' (Scott-Smith, 2018: 7) Describing how a given entity can adhere to other things, resist flow, or accommodate 'deformation', a theoretical vocabulary of stickiness and viscosity introduces 'friction and a landscape of textures' (ibid: 18), revealing how 'technologies come in a range of forms, from those that are expansive, frictionless and mobile (but also unstable and unsettled), to those that are firm, constrained, and bounded (but also paternalistic and inflexible).' (ibid: 7)

One challenge to infrastructure's presumed fixity comes from archaeologist Monica Smith, whose work treats infrastructure as 'materialised consensus', a form of conversation characterised by 'recursive and fluid engagement' between different actors. (Smith, 2016: 168). Though not immediately accessible to all, infrastructure and the built environment are manifestations of agency, tracking how 'people communicate with one another and modify their surroundings.' (ibid: 164) For researchers, users, and curious onlookers[15], it is often difficult to see beyond treatments of infrastructure as hardened, durable networks of artifacts. Spatially and temporally circumscribed, such encounters can only represent a momentary 'slice' through a longer conversation. A greater attention to the *longue durée* might reveal rhythms and counter-rhythms of call and response, with any given infrastructure as an 'incremental accumulation', comprising structures and features used over many generations. (Smith, 2016: 166)

Reading across this conception of infrastructure as sustained material 'conversation' (Smith, 2016), work on 'stickiness' (Scott-Smith, 2018), and conceptions of the heterogeneous infrastructure configuration (Lawhon et al. 2014; Lawhon et al., 2017), it is possible to get a better sense of how infrastructure can diverge from received expectations of its immutable stability. But where Monica Smith affirms the incremental construction, adaptation, and domestication of infrastructure as a public dialogue, accompanying the emergence of a common social field, the HIC is more *processual*, a 'stringing together' of diverse 'technologies, relations, capacities and operations' by less-powerful users, typically operating under 'conditions of precarity' (Lawhon et al., 2017: 7, 8). Where Smith's analysis accounts for the ways in which social relations produce enduring material effects, Lawhon and her colleagues stress the individualised and ephemeral character of such configurations, wrested from an often resistant environment, and comprising a

[15] For more on infrastructural encounters, see Mattern (2013), Angelo and Hentschel (2015), and my own approach to sociotechnical *flânerie*, described in Chapter 5.

flickering mesh of services that, on a day-to-day basis, are likely to collapse back into flux as they are to endure. Whether conversation or configuration, such infrastructures should not be mistaken for immutable mobiles. Instead, they show more or less 'stickiness' based on their users' relative power and agency—something particularly apparent in the cities of the global south.

In this section, I traced relations of mutability, mobility, and stickiness through the exemplar figures of the carrack, the bush pump, and the building, before bringing these concepts into dialogue with some of those theories of infrastructure introduced in the previous chapter. Moving forward, however, there is a need to move beyond exemplars and extreme cases, and attend more closely the gradations and crosscutting relations of *mutability* and *mobility* observed in other, more quotidian forms. In the rest of this chapter, I delaminate mutability and mobility, bringing the concepts from this section into dialogue with ideas from the previous chapter, and research carried out elsewhere.

3.3. Mutability

In focusing on mutability, I start from those three theories of sociotechnical change —LTS, SCOT, the MLP—introduced in the previous chapter. Those frameworks follow a *constructivist* approach to technology, tracing how innovations move from early prototypes, precarious and failure-prone, to stable, widely-adopted technologies. In these accounts, the assumption is that, however tortuous or controversial the process of stabilisation, the 'closure' of a system or artifact, once realised, then proves irreversible. For this study, such an approach would restrict my analysis to immutable mobiles, those entities able to hold their shape as they circulate between sites, while concealing the effort it takes 'to sustain stable networks of relations.' (Law and Singleton, 2005: 337)

Treating stability as a *fait accompli* renders more mutable entities anomalous or invisible. Tracking the above discussion of the immutable mobile and its variants, I follow Anique Hommels in working to achieve a more 'balanced understanding' of obduracy and sociotechnical change (Hommels, 2005: 330)—capable of accommodating the struggles, failures, and precarity of seemingly immutable objects, but also the successes of more flexible entities. This requires scrutinising existing work on obduracy and fluidity as qualities of infrastructure and the urban built environment, and the different processes facilitating their extension and modification.

3.3.a. Obduracy

The most comprehensive work on obduracy comes from Hommels herself (2000; 2005; 2008), adapting SCOT's accounts of stabilisation to cases from the world of urban planning. Echoing much of the LTS approach, she describes how size and complexity are often equated with stability, such that large urban structures come to be seen as permanent fixtures. (Hommels, 2000: 650) Although many top-down attempts to implement urban change, including the historical masterplans reviewed in the previous chapter, presume an 'almost infinite malleability of the existing urban configuration' (Hommels, 2005: 323), the reality is typically far less amenable:

> once the high-voltage electricity distribution system is in place, it is hardly conceivable to deconstruct it and shift to a decentralized system of windmill power generation; once a city's downtown area, including all its buildings, roads and distribution networks, is there, it … offers resistance to change. (Hommels, 2005: 329)

Generalising from her research on cities in the Low Countries, Hommels casts urban transformation as 'laborious, time-consuming, and precarious', forcing would-be planners or system-builders to choreograph a 'delicate interplay' of social, technical, cultural, and economic considerations. (Hommels, 2005: 328) Explaining the causal mechanisms of this intractability, she offers three broad heuristics, which interpret obduracy, respectively, as a product of *frames*, *embeddedness*, and *persistent traditions*. (Table 1)

Stressing the role of *dominant frames* and *framing*, the first approach applies to 'situations in which town planners, architects, engineers, technology users, or other groups are constrained by fixed ways of thinking and interacting' (Hommels, 2005: 331), which become difficult to ignore. The second such heuristic stresses a technology's *embeddedness* in a wider socio-technical field. When a particular configuration's constituent elements are closely intertwined, 'the changing of one element requires the adaptation of other elements' (Hommels, 2008: 27), something with wider consequences for the entire ensemble. In this telling, obduracy reflects a given entity's strength and density of outward-facing 'ties to other elements within a network.' (Hommels, 2005: 30) The final heuristic attributes obduracy to the influence of *persistent traditions*, with 'earlier choices and decisions' (Hommels, 2008: 30) continuing to influence a given technology's development trajectory. This casts obduracy as a form of material *endurance*, analogous to the momentum of large technical systems, or the inertia of a dominant socio-technical regime. For Hommels, this last approach differs from the other approaches in focusing less on local interactions than the forces that 'transcend local contexts' (ibid.).

Table 1. Three models of obduracy

	'Dominant frames'	*'Embeddedness'*	*'Persistent traditions'*
Explanatory mechanisms	Obduracy explained by constrained ways of thinking and interacting	Obduracy explained by close interconnectedness of social and technical elements	Obduracy explained by long-term persistence of traditions
Concepts and metaphors	Technological frames; paradigms; mental models; professional worldviews	Actor networks; irreversibilities; fixity and mobility of space	Momentum; trajectories; path dependence; city-building regimes; archetypes
Disciplinary background or intellectual tradition	Social Construction of Technology; history of planning	Actor-Network Theory; urban geography	Large technical systems approach; urban history; evolutionary economics
Type of explanation	Interactionist conception of obduracy	Relational conception of obduracy	Enduring conception of obduracy

Table 1: Three models of obduracy (Hommels, 2008)

Although the presentation of three different explanations may seem indecisive, Hommels contends that the scale and range of material elements constituting the urban built environment make it 'possible and justifiable' to integrate these approaches. (Hommels, 2008: 186) In this, her overarching goal is to gain greater purchase on how different actors work, with varying degrees of success, to disrupt, overcome, or unmake the 'sociotechnical status quo', intervening in the 'taken-for-grantedness' of the existing city, and 'making its obduracy flexible.' (Hommels, 2005: 324)

As an instructive example of obduracy's multiplicity, I turn to the dominance of the detached single-family house in contemporary Flanders. (Bervoets and Heynen, 2013) In this case, the obduracy of the building type reinforces extensive urban sprawl, a settlement pattern criticised for its aesthetics, inefficiency, inequity, and substantial environmental impact. (Bervoets and Heyen, 2013: 358) But despite these concerns, the type endures, resisting even incremental modification. At the single-building scale, these houses have a highly scripted spatial layout, 'with prescribed activities for each room … all specifically designed for the purpose of one single family' (Bervoets and Heynen, 2013: 367). Property owners express scepticism about using their homes in ways that diverge

from this script, citing 'respect' for the original designs. (ibid.) Many respondents emphasise the value they place on their independence, seeing any proposed subdivision of underused houses as a threat to their autonomy. (ibid: 368-369) A further contributing factor is something that, in SCOT, might be classified as a form of *closed-in hardness*, springing from the public's 'limited familiarity … with alternative housing forms' (ibid: 372).

The diverse sources of obduracy and resistance identified in this case demonstrate, I suggest, the utility of Hommels' multi-pronged approach. (Hommels, 2005; 2008) Obduracy is not 'an intrinsic characteristic or essence of this specific building typology', but the product of a 'complex entanglement of … heterogeneous elements which are all both cause and consequence' (Bervoets and Heynen, 2013: 373). Attributing obduracy to a complex entanglement of multiple factors is productive, and highlights the lack of obvious intervention points. Confronting obduracy, those looking to implement change must anticipate all the interacting elements, 'influencing them in conjunction' (ibid: 375), something that requires a comprehensive diagnosis of the situation and a clear vision of the desired outcome.

3.3.b. Fluidity

If obduracy is one endpoint on a continuum of mutability, *fluidity* is the other. For an obdurate entity, to take everything apart at the same time would result in 'the loss of identity.' (Law, 2002: 99) Fluid entities, by contrast, are characterised by *gradual* and incremental change, as 'some kind of more or less viscous flow' (Law and Singleton, 2005: 338). In the exemplar case of the Zimbabwe Bush Pump, we find a form of spatiality that is not just amenable to change, but actively *depends* upon it. Fluidity is a terrain in which no particular 'structure of relations' or 'boundary around an object' is privileged; and where 'mobile boundaries' prevent a fluid object from collapsing into incoherence, swallowed by its environment. (Law, 2002: 99-100) As a quality or characteristic, fluidity applies to the Bush Pump (*a mutable mobile*), but also to the low-cost, standardised buildings applauded by Stewart Brand, those more easily modified or adapted to better meet their inhabitants' needs (*mutable immobiles*). (Brand, 1994)

Mobilising this concept of fluidity in another case, Uli Beisel and Tilmann Schneider describe the changing material form of a Ghanaian *tro-tro*, or shared minibus. *Dr.JESUS*, a

Mercedes Benz 310 minibus, shuttles passengers between central Kumasi, Ghana's second-largest city, and its surrounding suburbs. One of many privately-operated, small-scale transport enterprises, this vehicle differs from its peers in having had a previous life as a German ambulance, before arriving in Ghana. (Beisel and Schneider, 2012: 640) An ambulance re-worked as a minibus, *Dr.JESUS* resists constructivist models of technological closure. The ambulance is not *broken*, it has not failed. It succeeds in its stated function; 'its engine is working, every day it transports people from A to B, and it provides two people with a salary.' (ibid: 651)

Addressing how 'spaces (re)configure objects and vice versa', Beisel and Schneider stress the entanglement of a given technology's transformation and its contexts. (Beisel and Schneider, 2012: 644) Situated within circuits of global waste disposal, goods flows, and an established Ghanaian vehicle repair and retrofit industry, the authors trace this vehicle back to Germany, describing how an ambulance then known as 7/83-2 was involved in an accident. Tumbling over a barrier, the vehicle suffered substantial damage, putting an abrupt end to its operational life. After this incident, a Ghanaian car dealer known to the German Red Cross handled the vehicle's journey to the city of Tema, its passage through customs, and subsequent transformation into *Dr.JESUS*. This reconfiguration saw four windows cut into the back and sides of the chassis, and the removal of seat belts, enabling more people to 'squeeze … onto the seats' (ibid.). These changes attest to the vehicle's fluidity—something that, for the authors, is 'not only a strength but also something threatening.' (ibid.) While the Zimbabwe Bush Pump was a laudable, loveable object (cf. de Laet and Mol, 2000), *Dr.JESUS* is not a 'pure success story' (Beisel and Schneider, 2012: 652), despite successfully fulfilling its stated function as a *tro-tro*. Here, the moniker '*Dr.JESUS*' not only gestures at the vehicle's medical past, but is also symptomatic of the role of religion and ritual in an uncertain, risky form of mobility.

The ambivalence of this transformation has clear implications for questions of generalisability, normativity, and appraisal. Looking at cases where infrastructure has been subject to extension, modification, or retrofit, it is important to recognise the *ambivalent normativity* and *context-dependence* of both obduracy and fluidity. Resisting the temptation to stage a simple, binary opposition in which fluid, mutable objects are equated with informality or lack, it proves more productive to recognise obduracy and fluidity as *relational* qualities, rather than categorical absolutes.

3.3.c. Extension and modification

Turning from obduracy and fluidity to the processes through which existing, seemingly stable systems are transformed, I focus on the *extension* and *modification* of otherwise obdurate forms. Following Monica Smith's conception of infrastructure as an unfinished material conversation, I attend to how this unfolds, with 'human activities and infrastructure's own agency of physical changes [resulting] in degradation and failures that require ongoing mitigation through modification and repair.' (Smith, 2016: 173) Here, I argue, a greater focus on smaller-scale technologies and alternative systems can illuminate the taming of obduracy and further-reaching patterns of change.

Working against constructivist theories' emphasis on fixity and closure, Kathryn Furlong coined 'mediating technology' to describe the growing presence and influence of 'small devices' added to an infrastructure with the aim of 'modifying its performance' (Furlong, 2011: 462, 460). These mediating technologies open the 'black box' of the system, reworking otherwise hardened relations among and between the technical network, its users, the environment, responsible institutions, and wider society. (ibid: 461) To take one example, the most immediately familiar 'mediating technology' from my own everyday life is the smart meter provided by our electricity and gas supplier—specifically, its user interface, an 'in-home display' that communicates how much energy our household is using, its pricing, and carbon footprint. Such devices see system maturation recast as something that involves increasing its 'visibility and user consciousness', with the aim of improving performance. (ibid: 463)

Where Furlong focuses on smaller devices and subsystems as agents of transformation, other researchers, such as historian Timothy Moss, have identified reconfigurations emerging from interactions between coexisting systems; citing cases 'where a new technology does not just coexist alongside or within a [system] but actually modifies it.' (Moss, 2016: 570) Looking for patterns in the development of alternative technologies, Moss distinguishes between solutions 'promoted by early pioneers and discarded by their successors' (*discarded surrogates*); adaptations of 'traditional practices at odds with modernized systems' (*modified traditions*); and technologies co-existing 'alongside the dominant centralized system' (*welcome complements*). (ibid: 651)

Moss applies this framework to Berlin's infrastructure systems, focusing on the 'chequered careers' of waste-derived biogas, agricultural wastewater reuse, and the cogeneration of heat and power. In constructivist accounts of sociotechnical change, each

of these systems should have disappeared once they failed to supplant the dominant technology. (Moss, 2016: 569) Instead, each coexisted with 'their respective [large technical systems] ... for at least a decade, if not permanently.' (ibid: 570) This was not a question of reluctant toleration, says Moss, but active encouragement, with the three alternative technologies 'promoted and managed by the [same] municipal utilities responsible for the city's main infrastructure systems.' (ibid) Illustrating the 'co-evolution of multiple technological pathways', these examples challenge the multi-level perspective's treatment of the sociotechnical regime as a conservative singularity—offering, instead, a glimpse of the 'messiness and contingency' of infrastructural transitions. (ibid: 571)

Extending this analysis of alternative technologies to the postcolonial cities of the global south, I return to the proliferation of petrol and diesel generators in the Nigerian cities of Kano and Jos. Appearing in both Brian Larkin (2008a) and Trovalla and Trovalla's accounts (2015a, 2015b), these works describe Nigerian infrastructural landscapes where generators loom large, 'chugging all over urban neighborhoods' (Larkin, 2008a: 76). With approximately 60 million household-size generations in use in Nigeria (Trovalla and Trovalla, 2015b), their ubiquity attests to the many failings of the country's electricity distribution grid; a consequence of, in Larkin's words, 'the collapse of the integrated infrastructural ideal and the withdrawal of the state's ambition to provide developmental progress.' (Larkin, 2008a: 76) The generator figures a 'rewired modernity', in which Nigerian cities are 'disconnected from a hegemonic domain of networked electricity and inserted into a world of generator monads' (Trovalla and Trovalla, 2015a: 341).

In this figure of the Nigerian generator, Furlong's 'mediating technology' (Furlong, 2011) and work on the role of alternative technologies in sociotechnical change (Moss, 2016) evince both the obduracy and 'potential malleability' of infrastructure. (Furlong, 2011: 460) Petrol and diesel generators may not be deeply embedded in existing systems and structures of energy provision, but with grid unreliability expected to continue over the longer term, the growing 'necessity of electrical autonomy' (Larkin, 2008a: 75) is starting to impact everything from the design of buildings to the rhythms of everyday life. Brian Larkin describes how the growing presence of generators is affecting the layout and space plans of new developments in Kano. In existing buildings, garages are 'given over' to these generators, while new developments include dedicated 'small buildings', bypassing the obduracies of a fixed space plan. (Larkin, 2008a: 75) In Jos, houses now often have 'a power switch which on one side says 'Nepa' and on the other 'Gen', the latter being a

common term for generator, the former the abbreviation of the National Electric Power Authority ... [now] a generic nickname for all grid-based electricity.' (Trovalla and Trovalla, 2015b: 45)

In his work on 'incremental infrastructure' in Ga Mashi, a neighbourhood in the Ghanaian city of Accra, Jonathan Silver foregrounds the activities of less powerful individuals, whose small interventions, comprising everything 'from new electricity connections creating free circuits of energy to low-cost, self-built housing systems', constitute systems 'in-the-making' (Silver, 2014: 788). Existing dwellings are converted for multiple occupancy, 'mutating and reshaping to the needs but also constraints of the [inhabitants].' (ibid: 799) New wires are laid, prepaid electricity meters are circumvented by 'creating a new room', while a 'new utility connection allows the dwellers to charge electricity to the business downstairs.' (ibid.) Comprising '*experiments* in material arrangements', these processes 'prefigure improved future conditions', as once-informal buildings 'develop the appearance and recognition of formal, robust structures', bolstering a given household's status and perceived right to land tenure. (Silver, 2014: 796) Where that earlier account of the Flemish detached single-family house described a typology obdurate to the point of intractability (Bervoets and Heynen, 2013), this Ghanaian account depicts a landscape open to 'experimentation with materials', reshaping incremental infrastructure as if conjuring 'a better tomorrow for the household or wider community.' (Silver, 2014: 799)

Silver's account of the weaving of incremental infrastructure between and through Ghanaian homes parallels elements of work on infrastructures as ontological experiments. In their account, Casper Bruun Jensen and Atsuro Morita talk of 'barely perceptible reconfigurations' as a distinct mode of change, the outcome of a 'continuous recalibration of relations' (Jensen and Morita, 2015: 85). The relative 'silence' of contributing actors, entities, and activities mean they often fall beneath the 'radar of public debate and controversy.' (ibid.) Ultimately, it may be this silence that allows these incremental infrastructures to thrive in urban Ghana; quietly addressing 'conditions of poverty, making possible flows of energy into households, [creating] new housing configurations, … [all] serving to channel resources toward the living of marginalized urban lives.' (Silver, 2014: 790)

In this section, I started developing some of the wider analytical framework suggested by 'immutable mobile' and its implied counterparts. Adopting mutability as a

sensitising concept, I reviewed a range of literature on obduracy and fluidity, using examples of the extension and modification of existing systems to better understand how infrastructure might resist or accommodate change. In the next section, I attend to questions of mobility, exploring how certain technological artifacts, policy initiatives, development models, and ideas about infrastructure have been able to move between locations, while maintaining their shape and identity.

3.4. Mobility

Where the previous section offered mutability as an alternative to constructivist accounts of technological closure, this section uses mobility to critique models of innovation diffusion and linear technology transfer. In the Rogerian model, diffusion describes 'the process by which an innovation is communicated ... among the members of a social system', presenting an explanation of social change as propelled by those processes in which 'new ideas are invented, diffused, … adopted or rejected' (Rogers, 1983 [1962]: 5-6). Establishing a mobilities-led approach to sociotechnical phenomena, a focus on translation over diffusion sheds light on the 'situated and intensely practical nature of the mechanisms involved in technology transfer' (McMaster et al., 1997: 65). Where research on diffusion dynamics sought to explain why some technology transfers succeed where others fail—establishing clear, predictable links between cause and effect—a mobilities approach follows information systems scholar Tom McMaster and his colleagues by addressing, in specific, practical terms, how innovations and new technologies are created, fortified, or displaced. (ibid: 73-74)

3.4.a. Translation

Yaakov Garb and Lonia Friedlander differentiate between *transfer* and *translation*. The traditional transfer model, they argue, sees technology:

> emerging from a ''core'' (in developmental terms), as a stable object with fixed characteristics, whose benefits are obvious, while the recipients in this equation reside in a ''periphery,'' who are grateful adopters, unaware of the benefits, or hampered by barriers and market failures that foil what would otherwise be the rational choice of adopting a technology whose benefits exceed its costs. (Garb and Friedlander, 2014: 15)

Although the temptation might be to supplant claims of linear transfer with more fine-

grained analyses of translation, they propose, instead, a spectrum between the two, the choice of metaphor resting on the subject's relations 'with analogous or adapted systems in new settings' (ibid: 16). Where a technology's autonomy is high and the process of linkage is smooth, it is easier to frame the process as a transfer, with material hardware 'moving from one site to another.' (ibid.) In cases where the relevant technology is 'deeply coupled' with its existing contexts, or 'not readily linkable' to systems in its new setting, translation or reinvention may provide more suitable metaphors for understanding what happens next. (ibid.)

As an example, consider Madeline Akrich's account of the Buena Vista Project, a French-funded attempt to import a gasogene, or wood gas generator, to a village without electricity in Costa Rica. With no 'active information transfer between the two countries', the project's technical specification was worked out in France. (Akrich, 1993: 293) From early on, the gasogene struggled with the local wood supplied as fuel, the result of its high humidity—a problem not anticipated by its French designers. (ibid; 294) Rather than modifying the device 'to render it compatible with local operating conditions' (ibid.), the developers instead constructed a drier for the wood, making the fuel source compatible with the gasogene. Illustrating the problems with a purely transfer-driven approach to technology diffusion, the construction of the gasogene as a stable, well-bounded immutable mobile impeded its adaptation to new biophysical conditions.

3.4.b. Mobilities

Where the metaphor of translation offers an alternative to accounts of effortless, frictionless technology transfer, a mobilities-derived approach can, I suggest, thicken and complicate Rogerian models of innovation diffusion. In the 1990s–2000s, a body of work by sociologist John Urry and his colleagues responded to an increasingly *global* social field, correcting a percieved sedentarist tendency amongst the social sciences, which had often black-boxed questions of travel and movement. (Sheller and Urry, 2006: 208) Gathering a 'set of questions, theories, and methodologies' (ibid: 210), this 'new mobilities paradigm' proposed ways to conduct social research when 'durable 'entities' of many kinds are shifting, morphing, and mobile' (ibid, 212).

Extending these same sensitivities to the analysis of policy and its circulation, more recent research on policy mobilities has departed from linear models of policy transfer,

which, in embracing a 'straightforward import-export metaphor' (McCann and Ward, 2012: 37), proved vulnerable to the same lines of critique levelled against Rogerian models of innovation diffusion. Approaching so-called 'transfer agents' as rational actors, 'who know what they are after and scan 'the market' for possible solutions' (ibid.), theories of policy transfer neglected the mediating role of social and ideological contexts, the politics of policy, and questions of implementation and practice. (Peck and Theodore, 2015: xxiii) The policy mobilities literature, by contrast, treats policies and their territories as 'constructed wholes' (McCann and Ward, 2013: 8), assembled from 'parts of the near and far, or fixed and mobile pieces … brought together … for particular interests and purposes.' (McCann and Ward, 2012: 328) Not only is policy adapted and reshaped to meet the requirements of new contexts, but the very mobilisation of policy, 'as a socio-spatial, power-laden process, often involves change along the way' (ibid: 329). My claim is that, as they move across territories, infrastructure and urban development models are subject to similar pressures, assembled and reworked by different actors to better serve their goals.

In their 2015 book *Fast Policy*, Jamie Peck and Nik Theodore assert the distinctiveness of the present moment, a situation where new policy ideas, particularly 'ideas that work,' can quickly find a worldwide audience and transnational salience. (Peck and Theodore, 2015: xv) Tracking the emergence and circulation of conditional cash transfer and participatory budgeting policies, they show how policy processes now overspill national boundaries, through adaptation, interconnection, and mutual referencing. (Peck and Theodore, 2015: 3, 20) Their argument is not just that the original policy designs rarely hold, evolving and mutating as they travel; instead, what is distinctive is the complex, unpredictable politics of the process, as policies are transformed in ways that, in significant respects, confound and contradict the visions of their original architects. (ibid: xx)

Today, policies rarely undergo linear transmission 'from sites of invention to sites of emulation, like some superior export product' (Peck and Theodore, 2015: xxiv). Instead, development processes operate in a 'multipolar universe' (ibid: 7), where circulating models and best practices make and remake connections between sites comprising

> sprawling networks of … consultants, web sites, practitioner communities, norm-setting models, conferences, guru performances, evaluation scientists, think tanks, blogs, global policy institutes, and best-practice peddlers, not to mention the more "hierarchical" influence of multilateral agencies, international development funds, powerful trading partners, and occupying powers. (ibid: 3)

In such a densely populated and unevenly contoured terrain, the *performativity* of innovation and policy transfer is key, operating more as 'an arena of contest and struggle' (ibid: 27) than any rational marketplace of ideas.

3.4.c. Domestication and appropriation

Even as work on mobilities and translation promise greater analytical purchase on urban infrastructure, they remain blind to the role of users, who are often treated as passive recipients of any new developments. Elsewhere, research on the domestication and appropriation of technology has demonstrated users' agency in reshaping technology to better serve their own needs. In this section, I highlight how such approaches differ from more economically driven models of innovation, or constructivist approaches to sociotechnical change. There is, I suggest, much to be gained from a greater emphasis on the determining role of culture and user practices—factors often neglected in discussions of technology, infrastructure, and urban change.

With limited literature on these topics, Andrew Jamison and Mikael Hård provide a useful overview, contrasting *economic innovation*, *social construction*, and *cultural approaches* as 'ideal-typical' accounts of technological change. A more culture-led approach, they suggest, would relate technology 'to particular life-worlds and practical activities' (ibid: 82), highlighting how practices of transfer, translation, and appropriation overlap and interact, unfolding in piecemeal, fragmented ways. (ibid: 88) As part of such an approach, research on domestication and appropriation share a common interest in the role of culture in 'digesting' technology, particularly in contexts characterised by power imbalances—whether between designer and users, or core and periphery. Technologies are never appropriated on a global or generic level, but filter into national, regional, and local traditions, through their interactions with situated organisational cultures. (ibid: 89)

An outgrowth of consumption studies, the *domestication* approach, as described and exemplified by the work of Leslie Haddon, initially focused on the symbolic meaning of possessions, objects, and products; but was later extended to media, particularly long-established forms, which, having outlived their own hype, provided fertile material for the analysis of how users work to make technologies their own. Attending closely to the processes shaping adoption and use, domestication researchers relied on interviews to find out what 'technologies and services meant to people … and the roles that these

technologies can come to play in their lives.' (Haddon, 2011: 312) The metaphor of domestication evoked a sense of 'taming the wild' (ibid.), as individuals and households dealt with new technologies, sometimes rejecting them (cf. Baumer et al., 2015), or else 'working out how exactly to fit them into their everyday routines.' (Haddon, 2011: 312)

Work on *appropriation* looks at how less-powerful users create new uses, modifying technology 'to make it their own and invent practices around its possibilities … with results that may not necessarily be congruent with the provider's interest.' (Bar et al., 2016: 626) Drawing on tensions evident in the early settlement of the Americas, François Bar and his colleagues outline three patterns of appropriation: *cannibalism*, which pursues processes of 'dismembering, absorption, and chemical transformation'; *baroquization*, an infiltration based on 'filling and layering'; and *creolization*, while relies on 'miscegenation and unpredictable mixing.' (ibid: 621-622) Each of these types represents a distinct form of cultural appropriation, suggesting different ways 'to negotiate power through creative practice' (ibid: 619). Attempts at appropriation typically result in protracted struggles over a given technology's configuration, as users, designers, and manufactures battle to assert power over 'who can use that technology, at what cost, under what conditions, for what purpose, and with what consequences.' (ibid: 618)

As one example of the appropriation and domestication of technology, I cite Ronald Kline and Trevor Pinch's work on rural users' re-scripting of the Model T Ford in the pre-war United States. Invoking and extending theories from SCOT, the authors describe a case where user actions changed the interpretation and design of an apparently stable artifact. (Kline and Pinch, 1996: 765) Farming households had started to view the automobile as 'more than a transportation device', deploying it as a general-purpose power source for a range of devices, including water pumps, hay balers, and wood saws. (ibid: 775) For rural users, the Model T 'could be a farm tool, a stationary source of power, part of a domestic technology, or perhaps all of these.' (ibid: 777) The diverging scripts and expectations of users and the Ford Motor Company created a complex site of struggle. Ford was initially ambivalent about these other uses, but, as secondary providers started supplying conversion kits, Ford responded by launching its own tractor and truck models, before working to block unauthorised practices of adaptive reuse.

For social historian Jan-Bart Gewald, this account of the appropriation and redesign of the Model T Ford parallels the experiences of 'anyone who has ever conducted fieldwork in Africa.' (Gewald et al., 2012: 7) Pushing back against the diffusionist models

that dominated colonial and postcolonial discourses, and centring local conditions and user demands, Gewalt and his colleagues describe 'how external innovations … embark on new, internal innovation processes in African societies and cultures' (ibid: 4). As a popular example, they cite the versatility of the Toyota Hi-Ace minibus, reworked to suit a range of different local conditions across the African continent:

> From the souped-up Zola Toyota Hi-Ace minibuses of suburban South Africa to the barely functioning *Matatus* in East Africa and the slogan-emblazoned *Trotros* of Ghana, these Toyota Hi-Aces are being used in ways and conditions that could never have been envisaged by Toyota's designers and automotive engineers ... Be it macho prowess and/or whitewall tyres in Johannesburg, the constraints of limited budgets and cut-throat competition in Nairobi or the desire to put across a message in Accra, the epitome of Japanese engineering prowess has been transformed in each case in unique and unanticipated ways. (Gewald et al., 2012: 4-5)

A substantive analysis of the Hi-Ace minibus would foreground its versatility and transformative appropriations, something that this chapter has cast as a product of the interplay of mutability and mobility; a set of relations able to account for the movement, mutation, and re-imagination of sociotechnical subjects as they circulate between settings. A greater focus on translation and mobilities can, I argue, meet growing calls to move narratives of sociotechnical change 'southward', investigating the distributed authorship of hybrid technologies and infrastructure systems. (Medina et al., 2014: 2-3)

3.5. Discussion

In this introduction to this chapter, I described the importance of moving from the broader, more abstract discussions of Chapter 2, to a closer, more fine-grained reflection on those concepts and theories able to illuminate salient dimensions of my subjects of study. Introducing the immutable mobile (Latour, 1987) as a way to probe the composition and circulation of different kinds of technology, I proceeded to disaggregate the concept. Taking mutability and mobility as cross-cutting factors, I showed how their presence, absence, interaction, and modulation can shape the form of a given technology, determining much of its workings and character. Taken together, these in-depth reviews of mutability and mobility lend greater depth and versatility to my mobilisation of the immutable mobile concept, and its implied counterparts. Having established a conceptual and theoretical foundation for this study, in the next chapter, I work to situate these concerns—mutability, obduracy, mobility, translation, and so on—in a particular research setting; namely, Ahmedabad, a city in Gujarat, northwest India, in the mid-2010s.

Chapter 4: Locating Ahmedabad

4.1. Introduction

This chapter introduces the setting of my research, the Gujarati city of Ahmedabad, in north-west India. I work to establish Ahmedabad as a field site, describing its spatial features, and locating it in a wider geospatial and sociopolitical context. The first part of the chapter addresses the difficulties in conducting single-sited observational research on infrastructure and other networked systems that overspill the confines of the local. Mindful of the challenges of researching urban sociotechnical change as a durational phenomenon, the second half of this chapter turns to questions of temporality and historicity. I start by describing the ebb and flow of colonial and nationalist ideas in Ahmedabad through the nineteenth and early twentieth centuries, before discussing independence leaders Jawaharlal Nehru and Mohandas Gandhi's contrasting approaches to science, technology, and infrastructure, and the impacts of these debates in the postcolonial Indian state. Jumping ahead, I then look at two more recent events perceived as moments of rupture—the liberalisation of India's economy and its opening to foreign investment in 1991, and the 2014 general election, in which Narendra Modi, then Chief Minister of Gujarat, led the BJP to a national victory, forming India's first majority government since 1984.

Taken together, the two parts of this chapter establish a backdrop for my observational research and analysis. Tracing Ahmedabad's particularities, with an eye to how its sociocultural and geospatial context might affect my efforts at theory-building, this chapter makes the case for the city's suitability as a site for my exploration of those relations of *mutability, mobility, and worlding*. In this, I start from the assumption that Ahmedabad is distinct from other field sites, a strategic, albeit 'equivocal' site (Heywood, 2015) rather than an 'arbitrary location' (Candea, 2007), and a space of productive difference well-suited to a study of infrastructure and urban change.

4.2. Where? Ahmedabad as field site and setting

Ahmedabad is a city of seven million people on the banks of the Sabarmati river, in north-west India. The largest city in the state of Gujarat, Ahmedabad falls between the

Arvalli mountain range to the north, the seasonal salt marshes and arid hinterlands of Kutch to the west, and the Gulf of Khambhat, a deep bay on India's Arabian Sea coast. Strategically positioned, the city was, historically, a key settlement on routes connecting north India and the Indian Ocean (Spodek, 2013), with a long history of marine traffic from Gujarat 'to the Gulf and the Red Sea, to East Africa, and to Peninsular South Asia' (Tambs-Lyche and Sud, 2016: 272). Today, Ahmedabad is India's seventh largest city. Unlike other top-tier cities, however, Ahmedabad is not the state capital of Gujarat. That role is fulfilled by Gandhinagar, a purpose-built administrative centre some 15 miles to the north. In addition, Ahmedabad was neither founded by, nor fully integrated into, the British Empire; instead, much of its development can be attributed to 'an indigenous strength implicit in its corporate tradition; a by and large hereditary plutocracy of a financial and mercantile elite.' (Nanda, 1994: 62)

Citing his own experiences conducting fieldwork in the early 2000s, Haarald Bekkers captures something of the hybrid, intermediary status of the city; at once 'bridgehead' and backwater, 'lacking a metropolitan flavor and appearing a little provincial' (Bekkers, 2005: 17). Some ten years later, Tomasso Bobbio describes Ahmedabad as undergoing rapid transformation, with 'new infrastructure, commercial buildings, shopping malls, and gated communities rising all around.' (Bobbio, 2013: 123) As I wait for a meeting with her husband and business partner, Radhika[16] responds to my questions about how Ahmedabad has changed over the past decade by drawing a comparison with the city of Udaipur, in Rajasthan, where she has family.[17] Far smaller than Ahmedabad, Udaipur seems to have succeeded in sustaining a sense of cultural continuity, even allowing for a substantial influx of French expatriates and other non-Indians. Left unsaid, as I understand it, is her sense that Ahmedabad has changed too much, too quickly, losing something of its character in the process. At the same time, spending time with Ahmedabad's younger residents, I, like anthropologist Parvis Ghassem-Fachandi, was often asked "Why did you come here?", 'as if the places from which I came must in any case be better.' (Ghassem-Fachandi, 2012: 12) For those who have spent significant time elsewhere, Ahmedabad can seem dull and pedestrian, but even its harshest critics acknowledge that, far from Delhi or Mumbai, there are fewer barriers to starting your own project or business, or trying something new.

[16] This is a pseudonym; for more on my treatment of anonymity, see Chapter 5, pp. 109–110.
[17] From field notes, 2 February 2016.

4.2.a. Urban morphology

Tasked with describing Ahmedabad's spatial structure and layout, commentators tend to draw a tripartite division, distinguishing between the historic walled city, the newer developments on the western side of the Sabarmati river, and a sprawling industrial periphery to the city's east. Characterising the city as divided, produced through 'spatial segregation' (Rajagopal, 2010: 531), many cite the spatial isolation of Muslims, and the elite's retreat to the river's western bank—'their attempt to escape disorder', as Bekkers describes, 'resembling a lizard shedding its tail' (Bekkers, 2005: 36). Parvis Ghassem-Fachandi explains how the Sabarmati's bridges have come to embody the dichotomies implied by these divisions, spanning 'rich and poor, new and old, functioning and neglected facilities, spacious and overcrowded, wide and dense, clean and dirty, Hindu and Muslim, safe and unsafe, peaceful and violent.' (Ghassem-Fachandi, 2008: 71) This sense of difference is sufficiently embedded that 'residents in east and west Ahmedabad increasingly experience and understand themselves as separate moieties.' (ibid: 69)

Perhaps because of Ahmedabad having avoided the full effects of direct colonial rule, the city's complex morphology is, today, characterised by a layering of different spatial logics, with surviving traces of 'various and diverse cultural influences.' (Nanda, 1994: 45) Among those that have endured, the city is known, architecturally, for its *pols*. Derived from 'pratoli', a Sanskrit word for the gate or entrance to an enclosed area, a *pol* is a self-contained neighbourhood, arranged around a central *chowk*, housing people of the same caste, religion, or profession. Within the *pols*, residents shared a temple or place or worship, wells, and common toilets. A domestic and vocational haven providing social homogeneity, security, conviviality, and economic opportunity in a multi-religious city, the *pol* typology allowed Ahmedabad's diverse communities to pursue parallel ways of life, separate but in close spatial proximity. (De, 2016; 2022) Recognised as the 'generic matrix' constituting the old city as 'a socio-cultural idiom and a physical space' (Nanda, 1994: 45.), these *pols* are a source of warmth and social belonging, offering their residents a sense of reliability and a platform to navigate or endure the rapid urban transformations happening outside. (De, 2016)

During my own time in Ahmedabad, I circulate between neighbourhoods either side of the river, juggling stays at mid-range hotels popular with business travellers, close to the eastern end of Nehru Bridge; a historic *haveli* in a Jain *pol*, owned and recently renovated by Rajiv Patel, an entrepreneur and property developer pivoting to focus on the

restoration of the city's neglected heritage properties; a Muslim-owned penthouse atop a mid-rise development housing a bank branch (and highly-regarded chicken restaurant) on Jawaharlal Nehru Road, at the edge of the segregated, Muslim-majority 'sub-city' of Juhapura (cf. Laliwala et al., 2021; Bobbio, 2022); and, finally, subletting a friend's room in the apartment he shared with his parents in Ambwadi, while he was travelling for work. With little motivation to venture east of the historic walled city, into the industrial belt, my experience of the Ahmedabad's shape and morphology came to turn on its cross-river divides.

As it has spread beyond the confines of its historic core, Ahmedabad has seen a morphological shift from the 'dense and compact fabric' of the walled city to 'a series of individual buildings on plots.' (Nanda, 1994: 62) Although many have now left the *pols* for apartment buildings and housing societies, there has been some reproduction of 'socio-homogeneity', with membership of these newer developments often comprising 'individuals with similar or comparable backgrounds ... [and] an administrative framework of rules and controls regulating their welfare.' (ibid: 63) This certainly reflects my experience lodging in Ambwadi, where the in-building social surveillance and gradations of public and private space paralleled those of the *pols*, despite dissimilar layouts and clear architectural constraints.

4.2.b. Socioeconomics and cultural politics

Any discussion of Ahmedabad's cultural politics and socioeconomic composition must address the 2002 Gujarat pogrom, three days of Hindu-Muslim violence following the burning of a train in Godhra, in which 59 people—mostly Hindu pilgrims—died. Writing about his own experiences on the periphery of these events, in which many hundreds were killed, Parvis Ghassem-Fachandi describes crossing Ahmedabad's Gandhi Bridge, picking his way past orange, plastic cubes and large stones which, he says, 'were supposed to block the entry to vehicular traffic' (Ghassem-Fachandi, 2008: 80). Walking to the middle of the bridge, he writes:

> I took a last picture of the old city from afar, and then stuffed it deep into my bag. Smoke was rising from fires in the east. It appeared as inverted pyramids, thin at the bottom, but spreading over the sky to cover the diverse areas of the old city. Something in the old city was burning, or, did the fires lie beyond it? … Once I had crossed onto the other side of the river into Shahpur, within a few city blocks, I was in the middle of peculiar scenes. I quickly passed one, then two, then three, then four cars upended, set on fire, and vigorously burning. … the street was full of dust and smoke. (Ghassem-Fachandi, 2008: 81)

Following organised killings in the city's eastern periphery, Muslims in the inner city 'fled their minority neighborhoods into majority areas, where their numbers were stronger.' (ibid.) Meanwhile, on the western side of the Sabarmati, Hindu gangs looted and burned Muslim shops and businesses. Crossing back into the west, Ghassem-Fachandi passes through the middle-class neighbourhood of Naranpura, home to Hindu and Jain families. Slowing his walking pace, he describes seeing 'married couples sitting on their garden swings (*hitchko*), enjoying the calmness of the day.' (ibid: 85) These residents had no interest talking with someone who had been on the other side—'families swung back and forth, and they wanted to be left alone.' (ibid.)

During my own fieldwork, almost 15 years later, the violence was a lacuna, palpable in its absence. My only substantive engagement with the events, at some remove, came during a visit to the Conflictorium, a small community museum in Mirzapur, in the old city. In the words of Shefali, a Conflict Management graduate and museum volunteer:

> The biggest skirmish between Hindus and Muslims, and the consequent class and racial discrimination that followed, has divided Ahmedabad. Another division that Ahmedabad faces is of the new and old cities. The new city is a hub of the arts—with exhibitions and arts and design colleges—that compels a certain kind of intellectual discussion. The old city, on the other hand, has the general aura of being stuck in time. There still exists a perception that the old city is the trigger for most conflicts that take place in Ahmedabad. The Conflictorium was started to bridge the gap between the two. (cited in The People Place Project, 2017)

Established in the home of a Parsi woman credited as Ahmedabad's first hair stylist, the Conflictorium was not designed or built as a museum but is '*articulated* as such' through the activities of its staff, volunteers, and visitors, 'without any preconceived or essentialized function of the space' (Landau, 2021: 168). Surrounded by a Muslim shrine, a Hindu temple, a church, and a government-run vocational training centre, the space provides the 'physical room and intellectual space to express diverse and possibly contradicting opinions.' (ibid.) A series of participatory, immersive displays offer 'contexts which accumulate narratives of the experiences and memories of its visitors' (Rajendran, 2016). In my own visit, I was struck by these exhibits' sentimentality[18], enacting 'non-linear narratives that do not reference specific incidents in the history of Ahmedabad', but required interpretation, 'mak[ing] active participants of the viewers' (ibid.).

Despite the enduring divisions evoked in the Conflictorium, and the experience of 'calamitous events like floods, earthquakes, pogroms and communal riots,' Ahmedabad is, in quieter times, 'a city of calm and prosperity … [busying] itself with infrastructural

[18] From field notes, 12 February 2016.

improvements in an atmosphere of endless growth.' (Ghassem-Fachandi, 2012: 12-13) Formally granted 'megacity' status in 2005, as part of the central government's Jawaharlal Nehru Urban Renewal Mission[19], Ahmedabad is increasingly portrayed as a safe, 'world-class' city, with 'flyovers, high-rises and luxurious gated communities.' (Mehta, 2016: 192) Citing the influence of a 'nexus between the middle class and neoliberal politics', political scientist Mona G. Mehta describes how the 'megacity' label has sanctioned and valorised the city's material reconfiguration, further elevating 'private capital, global market forces and middle class aspirations' while obscuring urban inequality; recasting 'uncomfortable memories and realities' in a 'language of nostalgia, community and heritage.' (ibid: 194)

Reviewing writings on Ahmedabad, I am struck by the recurring use of a lexicon of laboratories and experimentation, by writers, researchers, and Gujarati public figures alike. Paralleling earlier discussions of urban laboratories as a model of sociotechnical change[20], Ahmedabad, past and present, has been figured as a laboratory for new models of economics, politics, or sociality. In many accounts, this starts with Mohandas Gandhi and his Sabarmati Ashram. Returning from South Africa to India in 1915, Gandhi chose Ahmedabad as the location for his residence and operational headquarters. The city was the right size, in the right location, and with the right level of connectedness, close enough to Bombay to cover the distance in an overnight train journey. From a base in Ahmedabad, Gandhi 'could get his message out—he … could keep in touch with the world and the world could reach him.' (Spodek, 2013: 751) At the same time, the ashram provided a space for the development and application of ideas around 'communal living, caste relations, sustainability, experiments with khadi, … and labour management' (Thomas, 2015: 36). Its presence turned Ahmedabad, a city 'still rooted in its own traditions, but responsive to new global movements' (Spodek, 2013: 762), into a 'laboratory for experimenting with techniques of social cooperation and mobilisation' (Bobbio, 2015: 4-5).

In his writings, Gandhi rejected cities and urban life as a template for the modern Indian nation, decrying it as a 'spatial outcome' of Western civilization, and, as such, 'incompatible with the socio-economics of India.' (Thomas, 2015: 36) In this light, the notion of a Gandhian urban laboratory may seem riven with contradictions. Nonetheless, the Sabarmati Ashram fulfils the definitional criteria laid out by Andrew Karvonen and Bas van Heur. Locally situated, the ashram worked to legitimate new experimental practices

[19] An urban infrastructure and development scheme releasing central government funds to cities selected on a competitive basis, which ran from 2005–14,
[20] See Chapter 2; pp. 28–30.

within prescribed boundaries, operating at a scale and in a site selected for 'its opportunities for success' and a perceived 'desperate need for different conditions.' (Karvonen and van Heur, 2014: 387) Despite Gandhi's hostility to cities, the ashram and its participants embraced 'the complexity and fluidity of urban change processes' (ibid: 388), taking a multi-pronged approach to the development and promotion of a Gandhian ethos, through training, grassroots organisation, and awareness-raising.

A second such laboratory can be identified in the Ahmedabad of the late 1990s, following the closure of the textile mills that had once dominated and sustained the city's economy. At this time, Hindu political organisations began experimenting with new forms of 'mass mobilization among the working classes' (Bobbio, 2013: 127), while pursuing urban development and infrastructure projects that 'sought to transform Ahmedabad into the state's storefront for promoting private investment.' (Bobbio, 2012: 662) Modernity, globalisation, and development became keywords for a supposed Gujarati economic miracle, with the ideal of a 'traditional mercantile culture' providing a backdrop for the state, with Ahmedabad as a 'showcase', to become a 'natural environment for economic development.' (Bobbio, 2015: 158) Politicians and state leaders at this time frequently described Gujarat as a '"laboratory" of Hindutva' (Chandrani, 2013: 183), leveraging Hindu nationalism and regional pride to package and sell neoliberal development policies to the populace.

Ahmedabad at this time was a roiling cauldron of disparate but interlocking currents, as close to a century of Gandhian politicisation combined with

> deeply felt religious identifications augmented by the support of overseas relatives and friends, and sometimes expressed in an opposition to the 'other'; an economy in total transformation from an industrially oriented past to an uncertain future; an economic leadership eager to emulate the successes of other developing regions resulting in increasing disparities of wealth and poverty; a public culture riddled with illegalities [such as liquor bootlegging]; and years of experience with the use of violence for political purposes. (Spodek, 2010: 371)

This urban political laboratory had both inscriptive and performative dimensions, constituting a palimpsest of 'ethno-religious, entrepreneurial neo-liberalism' and 'sterile, abstract scientism', which, taken together, defined the contours of a 'new urban politics.' (Chatterjee, 2011: 2574) This, I feel, is a productive way of emphasising the distinctive features of municipal neoliberalism in Ahmedabad—a political logic, implemented as an experiment, 'according to existing politico-institutional path dependencies' (ibid: 2579)

With Ahmedabad frequently deployed as a symbol of Gujarat's urbanity, projects

including the Sabarmati riverfront redevelopment[21] and Janmarg Bus Rapid Transit[22] came to stand as 'signs of its global readiness … indispensable to Gujarat's argument for good business.' (Thomas, 2016a: 144) An outward-facing message of 'urban infrastructure projects, real estate activity, finance hubs and special economic zones ... [indicated] the global readiness of Ahmedabad and its peripheries' (Thomas, 2016b: 45), while playing into the aspirations of the city's newly-empowered urban middle class, using tropes and imagery 'shaped on the stereotypes of globalised modernity' (Bobbio, 2015: 5-6). Playing to audiences both at home and abroad, this message worked to re-brand the city, transcending and erasing memories of the industrial ruins of the 'Manchester of India.' (ibid: 5)

4.2.c. Siting and situating infrastructure

It is the day after Christmas, and my friend and I are in the final stretch of a five-hour taxi journey from Ahmedabad to the city of Gandhidam.[23] This is the first leg in a three-part journey to Bhuj, for an end-of-year, state-supported package holiday on the White Rann, a seasonal salt marsh in west Gujarat. Crossing a bridge over the easternmost part of the Gulf of Kutch, electricity pylons thread a landscape of water and salt pans. I take a photo of a cluster of wind turbines from the taxi window, later identified, after some legwork on Google Maps, as the Surajbari wind farm. Initially comprising ten wind turbines manufactured by the Danish firm Vestas, and installed in the villages of Vandhya, Jangi, Shikarput, and Modpar, this wind farm feeds into India's NEWNE (Northern, Eastern, Western, and North-Eastern) grid, a grouping of smaller regional distribution networks, now thoroughly cross-connected. The power generated by these turbines will be sold to the Tata Power Trading Company Limited, a subsidiary of one of the many divisions of India's Tata Group.

Time passes. One Sunday in March, I join eco-tourism group Diving Deep on a day-long Jeep trip from Ahmedabad to the Gulf of Khambhat, to experience the coastal mudflats and see the impact of NGO-supported mangrove planting efforts.[24] After exploring the mudflats, we drive a little further down the coast to a fishing village, where, as a group, we help launch a fishing boat from its beaching, straining against the wet mud.

[21] See Chapter 8; pp. 205–210.
[22] See Chapter 6; pp. 139–142.
[23] From field notes and photos, 26 December 2015.
[24] From field notes and photos, 6 March 2016.

Joined by the captain and a couple of other fishermen, we navigate the boat from the channel and into deeper waters, its engine belching a thick cloud of charcoal-coloured exhaust. Looking to the far side of the bay, I glimpse the flame of an active gas flare stack, later identified as part of the Petronet LNG Terminal at Dahej, which receives and regasifies maritime shipments of liquefied natural gas. These LNG shipments are imported from Qatar in three Petronet vessels—*Disha*, *Raahi*, and *Aseem*—sailing under a Maltese flag of convenience. The Dahej terminal is but one node in distribution networks operated by Gujarat Gas and the Indian national gas authority, with connections not just in-state, but also by pipeline to other nodes in Madhya Pradesh, to the east, and Maharashtra, to the south.

These encounters illustrate some of the representational challenges in describing infrastructure under conditions of globalisation. Large infrastructural systems are slippery phenomena; simultaneously things and 'the relationship between things' (Larkin, 2013: 329), often opaque or removed from view, with a networked structure that overspills the constraints of the local. Such systems may be present in a particular setting, but their presence is displaced by the flows they facilitate. They are also characterised by a separation, in both time and space, between their design, construction, and use.

As Jenna Burrell notes, fieldworkers' movements no longer neatly map to the spatial contours of social phenomena. (Burrell, 2009: 186) The distinctive features of infrastructure have implications for my methodology and research design, inflecting how I relate to Ahmedabad as a field site. There are other ways of constructing or delineating a research site beyond those typically seen in the ethnographic literature, while continuing to meet the challenge of pulling 'something coherent forward from ... overlapping and intertwined social terrain.' (ibid: 184) In this section, I explore a couple of different possibilities, highlighting writings on multi-sited and mobile ethnography (Marcus, 1995a; Blok, 2010), and the field site as an 'arbitrary' or 'equivocal' location (Candea, 2007; Heywood, 2015).

In his work on multi-sited ethnography, George E. Marcus describes an approach to research 'designed around chains, paths, threads, conjunctions, or juxtapositions of locations' (Marcus, 1995a: 105). In such multi-sited ethnography, the field is not congruent with a physical space, but, instead, constitutes a series of sites strung together by the researcher's argument. Focusing on emergent objects of study 'whose contours, sites, and relationships are not known beforehand', the researcher seeks an 'explicit,

posited logic of association or connection' (Marcus, 1995a: 102, 105). Providing a way to study global or transnational phenomena, and loosen the 'straitjacket of the bounded field-site' (Lapegna, 2009: 17), researchers are instead urged to pursue people, artifacts, metaphors, plots, allegories, biographies, conflicts, and so on, between locations—'*Follow the thing*!' (Marcus, 1995a)

Responding to Marcus, Matei Candea defends the traditional, bounded field site as an 'arbitrary location' (Candea, 2007); an independent variable beyond the control of the researcher, and a constraint to be embraced in a 'spirit of methodological asceticism' (Heywood, 2015: 866). This arbitrary location is arbitrary 'insofar is it bears no necessary relation to the wider object of study.' (Candea, 2007: 180) By treating the local research site as a 'contingent window into complexity' (ibid.), the fieldworker can preserve multi-sited ethnography's sense of a 'seamlessly interconnected' world, without 're-naturalizing a different set of 'larger' but equally bounded forms (Cook et al., 2009: 57)—replacing the remote village setting, for example, with India's overseas diaspora, a gas pipeline, or the transnational supply chains of the garment industry.

Taking a different approach, Anders Blok outlines a 'mobile ethnography of situated globalities' (Blok, 2010). In work on globalisation, the challenge is in mapping global relations and connections empirically; something seemingly incommensurate with the ideals of local ethnographic fieldwork. (ibid: 507) Conceding that 'socio-spatial sites of local and global' may be 'set up in such a way as to *resist* all empirical mediation', Blok urges researchers to attend to 'couplings' of the semiotic and material. (ibid: 508-509) This, he suggests, can reveal how the movement of less mutable entities helps produce different versions of the 'local' and 'global'. (ibid: 514) By sustaining an 'ethnographic interest' in worldings and scale, researchers can track how different localities are materially and discursively linked, through 'more-or-less global-scale connections' with sites and spaces elsewhere. (ibid: 509) In research terms, this requires short-circuiting local-global binaries with new metaphors, including networks, mobility, and cartography. (ibid: 522)

Extending and developing Candea's argument, Paolo Heywood approaches the field site as an 'equivocal location', a site of productive difference—from the ethnographer's expectations, from conceptual and theoretical discussions, and, in some cases, from itself. (Heywood, 2015) In this, the idea of the equivocal location recognises 'that whilst there may be a relationship between ... [a] field-site and a given analytical object, that

relationship does not have to be one of equivalency or representation.' (Heywood, 2015: 858) Starting from a recognition 'that relations can be established across difference rather than simply similitude', this approach concedes that different indexings of 'infrastructure', 'innovation', or 'urban development' might, in fact, refer to different objects; with such 'varied understandings … not a problem requiring resolution, but a productive feature' of research. (ibid: 865)

Reading across these different ways of constructing a field site, my own approach to siting this study combines elements of Anders Blok's proposed mobile ethnography of situated globalities (Blok, 2010), attending to worlding practices, and Paolo Heywood's discussion of the field site as an 'equivocal location' capable of foregrounding relations of difference. (Heywood, 2015) Acknowledging that infrastructure systems exceed or overspill Ahmedabad's local boundaries, I have situated and constructed my field site in a way that can accommodate the city's messiness and divisions, alongside its simultaneous roles as—for example—a laboratory for new sociopolitical and economic models, a mooring for foreign capital investment, and a beneficiary of smart city and world heritage labels. Remaining attentive to different actors' indexing and enactments of infrastructure, development, and urban change, this treatment of Ahmedabad as a field site also allows me to address any slippages between analytical and empirical concepts, while mapping relations of *mutability*, *mobility*, and *worlding*.

4.2.d. Ahmedabad and the metonymic city

As an example of the perils of generalising from a single case, urban geographer Andrew Harris describes how the city of Mumbai was elevated as an exemplar and metonym for new forms of urbanism; mobilised in popular and academic discourse as a paradigmatic yet exceptional 'global city', and a convenient urban container for a range of anxieties, diagnoses, and prognostication. Noting the adjectival use of 'global' as an abstract analytical framing seemingly preferred over any detailed studies of the city's 'myriad, messy and ever-changing popular and political worlds', Harris flags the 'danger that certain theories, geographical predilections and comparisons are mapped onto Mumbai' with little evaluation of their suitability. (Harris, 2012: 2961, 2967)

Connecting this with my own work, while remaining mindful of discussions of the potentially productive role of arbitrary and equivocal research sites (Candea, 2007;

Heywood, 2015), I am faced with further questions about my own engagement with Ahmedabad. What role does Ahmedabad fulfil in the popular or collective imagination? What is this apparently singular city an instance of? Although my choice of field site was, in part, an opportunistic decision, capitalising on a general familiarity with the city and the relative strength of my existing social ties, I started my research with certain foreshadowed problems. (cf. Malinowski, 1922) Specifically, I imagined a fast-growing, second-tier city with clear evidence of infrastructural development would be less exceptional than Delhi's National Capital Territory or the 'maximum city' of Mumbai, providing a generative site to investigate infrastructure development, the obduracy of the built environment, and patterns of urban change.

In the event, the outcome of India's 2014 general election, and Narendra Modi's subsequent appointment to the office of prime minister, challenged many of these early expectations, while profoundly shaping my research experience. As the political architect and system-builder responsible for many of the urban projects I encountered, Modi's absence was palpable as I explored the city, while initiatives modelled on those already implemented in Ahmedabad and Gujarat were replicated on a national scale. This experience made it far harder to approach Ahmedabad as a generic second city, demonstrating continuity with urban development patterns elsewhere in India.

Instead, it has been tempting to treat Ahmedabad as microcosm or metonym of a conjuncture of neoliberal urban development and majoritarian politics. Certainly, I would not have been alone in doing so. To take one example, we might consider investigative journalist Amrita Shah's 2015 city biography, *Ahmedabad: A City in the World*. Shah's book contributed the 'digestion' of the 2002 Gujarat pogrom, a process in which

> journalists, scholars, intellectuals, writers have filled hundreds of pages in analysing the facts, looking for explanations and responsibilities to distribute in order to understand how such events could happen in a modern and pluralist democracy. (Bobbio, 2015: 2)

In this reading, Ahmedabad becomes a problem to be solved, its multiple divisions and history of violence standing as evidence of a broken or incomplete democracy. At the same time, the city has also served as the storefront of a 'capitalist development state' that, stabilised as the so-called 'Gujarat model', offered a vision of 'one of many possible futures for global capitalism in the so-called developing world.' (Desai and Roy, 2016: 2)

As in Harris's reflections on the mobilisation of Mumbai as an exemplar case (Harris, 2012), there is a risk that this greater spotlight on Ahmedabad might come with certain conceptual, geographical, and political limitations. Consequently, and as a means of further

situating and specifying my analysis, in the second half of this chapter, I complement this understanding of Ahmedabad as terrain with a deeper understanding of the temporal and historical forces acting on my chosen research subjects, in this city, in the mid-2010s.

4.3. When? Ahmedabad in Modi's India

Having located the city of Ahmedabad in a spatial and sociocultural context, I now turn to the question of time. In undertaking a study that focuses, in part, on the dynamics of urban sociotechnical change, there is value in also establishing a *temporal* setting, locating my research in time, as well as space. Having undertaken a total of ten months of fieldwork in Ahmedabad between January 2015–May 2016, my research material, even when triangulated against secondary and historical sources, can only ever represent a series of short slices through much longer-lived phenomena. Foregrounding questions of temporality and historicity[25] is also an effective way to appreciate the particularities of Ahmedabad's urban trajectory, conveying a sense of the events and developmental pathways that have influenced the city's present form and composition.

Appreciating constructions and performances of history in the here-and-now, a greater sense of historicity complicates treatments of the past as an inert object 'amassed and inserted into research, based on static facts.' (Glass, 2016: 93) Taking urban sociotechnical change as one of my subjects of inquiry, it is important to see how relations of continuity and change have 'particular significance with respect to extra-European societies.' (Arnold, 2005: 90) Where European models of history presuppose a disconnection of past and present, this can differ in Indian settings, where 'connections between past, present and future' (Hirsch and Stewart, 2005: 262) see different times folded together or superimposed. Though it may initially appear counterintuitive, we can substantiate this claim by scrutinising 'how cultural representations of the past [and future] are structured by present concerns.' (Birth, 2008: 14)

As a tangible example of historicity in action, I cite a December 2015 *Economist* article on Gujarati business practices, headlined 'Going Global.' (Economist, 2015) Opening with examples of the role of the Gujarati diaspora in bootstrapping businesses in nineteenth-century Zanzibar and the post-war United States, speculating as to whether

[25] Anthropologists Eric Hirsch and Charles Stewart differentiate 'historicity' from history, as an umbrella term denoting the different ways 'persons operating under the constraints of social ideologies make sense of the past, while anticipating the future.' (2005: 262)

Gujaratis 'around the globe' will 'continue to enjoy the same success in the future' (Economist, 2015). The article points to various historical, geographical and social forces underpinning a Gujarati emphasis on trade and entrepreneurship—something aligned with the publication's own liberal, pro-market leanings. Echoing the Gujarat state government's own promotion of an indigenised 'middle-class' ethos, the article constitutes an active construction of historicity, borrowing 'typical elements' of Gujarati tradition, 'specifically from an upper-caste Brahmin or Bania fold, [and] mixing them with the stereotypical features of a globalised society' (Bobbio, 2015: 158). Problematising treatments of history as a static, neutral object, this case sees *The Economist* uncritically reproduce a 'cultural representation … structured by present concerns' (Birth, 2008: 14), contributing, perhaps unwittingly, to Gujarat's efforts to attract nomadic capital to the state.

4.3.a. Empire—and its aftermaths

Approaching Ahmedabad as a postcolonial city, shaped by the enduring legacies of British rule, I am sensitive to the temporalities and historicity of colonialism. As Felix Ringel argues, in his work on the 'postsocialist' and 'postindustrial' city of Hoyerswerda:

> any 'post-' ascriptions implicitly impose and inscribe a certain temporal logic as a property by presuming, first, that the object has a past which it broke away from, … and, second, that its past continues—with or without the break—to determine, condition, or affect its current existence in some casual way. (Ringel, 2016: 395)

How can a city, region, or era be postcolonial? Capturing concurrent dynamics of rupture and endurance, 'postcolonial' can denote a period (after the colonial) and/or a location (where the colonial was). (Anderson, 2002: 645) To illustrate this double meaning, I share an encounter from my fieldwork, showing how state and district governments use provisions of colonial-era legislation to impose temporary states of emergency, through mobile internet bans and restrictions on public gatherings.

On a Sunday morning in February, a scratch card in sealed plastic promising access to hotel wifi delivers me, instead, to an error message.[26] Levering the local pay-as-you-go SIM card from the handset of my cheap local mobile phone, I slide it into my Vodafone-branded internet dongle and plug it into my laptop's USB port. Again, no luck. At a loose end, and seeking a late breakfast, I walk a couple of blocks to a local heritage hotel's courtyard cafe, picking up a copy of one of the English-language daily newspapers from a

[26] From field notes, 28 February 2016.

vendor sitting out front on the roadside. Spreading the paper across the dining table, I quickly identify the source of my connectivity failure: a four-hour suspension of internet services, ordered by the Ahmedabad district collector, to prevent the 'misuse of mobile phones' in a state-wide recruitment exam for government accountants; something I initially struggle to believe.

This development followed the precedent of a prior suspension of mobile data, 3G and 2G internet services, imposed the previous August, in response to agitation by urban-dwelling members of the Patidar community. Led by Hardik Patel, a water pump repairman turned student activist, protestors rallied for inclusion in the Other Backward Class category, which would have made them eligible for affirmative action reservations in higher education and public sector employment. (Jaffrelot, 2016; Miklian and Hoelscher, 2017) Citing the threat of escalating conflict, Ahmedabad's Police Commissioner 'shut off' mobile services for 57 million Gujarati phone accounts for nine days, 'banning texting, internet, and the ability make emergency calls.' (Miklian and Hoelscher, 2017: 7) This case saw local authorities making use of powers granted under Section 144 of India's 1972 Code of Criminal Procedure, a direct transplant from its 1898 colonial predecessor, which grants state governments the power to curb gatherings seen as an imminent threat to public order. An apparently arbitrary exercise of power, with few checks and balances, I again follow Felix Ringel in citing this as a 'postcolonial' situation; one of innumerable such cases signalling a break with a colonial past, even as the artifacts and structures of that history continue to press on the present. (cf. Ringel, 2016)

Contending with the temporalities and historicity of empire, it helps to understand how Gujarat's colonial experience diverged from that of the rest of India. British merchants and traders were present in Surat, on the Gulf of Khambhat, from 1612, and, from 1759, the British East India company came to share a 'certain amount' of authority with the local Nawab. (Williams, 2001: 8) The British leveraged this situation for further influence, not through war or treaty, but, in the words of Sir John Malcolm, Governor of Bombay, as 'mediators between parties in a country torn by factions, and in which all rule was disorganized.' (Malcolm, 1833: 6-7) Although the British took of control of Ahmedabad and its surroundings in 1817, colonial Gujarat remained divided in two. One part was incorporated into the Bombay Presidency, and 'directly administered' by colonial forces, while the other remained a patchwork of princely states, 'operating under the supervision of residents and political agents appointed by the British.' (Williams, 2001: 9) Ahmedabad was part of area held by the British, but even here, there was a 'relative

absence' of colonial institutions. (Tambs-Lyche and Sud, 2016: 274-275) The city's existing mercantile bodies and corporate forms of governance were displaced not by British administrators, but new Hindu and Muslim elites, whose power derived from their links to the colonial state and successes in the local cotton and textile economy. (Chandrani, 2013: 118)

Before the arrival of the British, Ahmedabad had long served as a key node in commercial and trading networks active in northwest India, but the arrival of the railway in 1864, and resulting growth in export trade, turned the city into more of an *entrepôt*; a hub for import, export, and distribution. (Raychaudhuri, 2001: 682) Flush with profits from the textile industry, local elites invested their wealth in Ahmedabad's development, such that industrialisation was less a modernisation drive patterned on the British example, than a 'weighing of alternative investment opportunities.' (Bekkers, 2005: 20) Siddhartha Raychaudri argues that Ahmedabad's experience of urban sociotechnical change was distinctive in that it was not simply a product of colonial domination, but, rather, a situation where local elites contested the government's restructuring of the city, taking control of Ahmedabad's municipal governance structures and working 'to bring about their own reorganization' (Raychaudhuri, 2001: 678). Starting in 1924–25, this domestic elite implemented an economic and spatial reorganisation of the city, reconfiguring its urban built environment to embody an indigenised version of modernity. (ibid.) On the whole, Ahmedabad's inland status meant that it was of less strategic interest to the British, and, as such, afforded a more prominent role for such local elites. It is perhaps this that proved instrumental in Gandhi's choice to use the city as a home base for his social, political, and educational activities. (cf. Spodek, 2010)

Gujarat as it exists today is still a recent creation, with ideas of Gujarat and *Gujaratni asmita* (regional pride) first elaborated by British and Gujarati writers in the nineteenth century. (Chandrani, 2013: 176) Prior to this, there was little sense of a Gujarati identity, and understandings of the past rested on 'knowledge of one's own caste or community genealogies' (ibid: 177). Established in 1960, Gujarat state was 'cobbled together' from a patchwork of territories encompassing 'the former princely State of Kutch, the innumerable [states] in Saurashtra, and the north-western Gujarati-speaking and tribal territories of the former Bombay State.' (Desai, 2011: 367) With many members of the Gujarati capitalist and professional classes having thrived within the institutions and urban centres of a united Bombay State, this division was a clear victory for the Marathas, who took Bombay as the capital of the new state of Maharashtra. Within Gujarat, the

state's new institutions were quickly dominated by a 'bourgeois power constellation, centred on Ahmedabad', reducing the princely and landholding 'former elites' to a 'subordinate position.' (Tambs-Lyche and Sud, 2016: 273) Many of these divisions endure today, even on a quotidian level, where one can detect tensions between local, sub-regional identities and a 'rather top-down … Gujarati identity-building project' (ibid: 280) —as seen in Sanderien Verstappen's research on the role of the Gujarati diaspora in remaking different 'regions' of the state. (Verstappen, 2017)

4.3.b. Modernisation and Nehruvian technoscience

In the aftermath of Indian independence, there was a clear split among the country's leadership over the proper role of science and technology in the new state. While free-market liberals and Marxist modernisers agreed that India had to develop 'big industrial and military technology to catch up with the west', Gandhians and revolutionary leftists sought to 'develop tools more appropriate to small-scale village economies.' (Philip, 2016: 278-279) Despite differences in opinion, all those involved in this conversation shared a common assumption that most of India was not yet ready for 'the latest, fastest, slickest, most advanced technology.' (ibid.) As Govind Gopakumar describes, in the initial years of this new state:

> A widely held ... belief was that the full force of planning directed at Indian cities would quickly resolve any residual problems ... placing them securely on the path to modernization. Once that could be accomplished, the developmental energy of the new nation could then be redirected almost exclusively at villages. (Gopakumar, 2020: 69-70)

Modern infrastructure and technoscientific industries would thus be limited to India's cities and national networks, while village populations required only 'those "appropriate" technologies that could sustain rural production.' (Philip, 2016: 279)

Today, this emphasis on the developmental role of state planning and 'big science' is most closely associated with Jawaharlal Nehru, India's first prime minister, who used central government, national institutions, and the state's control of science budgets to 'build a scientific establishment sympathetic to his views.' (Arnold, 2013b: 367) Assuming direct responsibility in his first cabinet for atomic energy, natural resources, and scientific research, he promoted a technoscientific consensus that charted a path between state and market, with a key role for central economic planning. (Siddiqi, 2015a: 38) Progressively delinked from the figure of Nehru himself, 'Nehruvian' rhetoric posited a 'trio of seemingly self-evident and sequential axioms' (Siddiqi, 2015b: 342): that India needed to be modern,

that India needed science, and that 'science and an independent state mutually legitimize each other' (ibid.); a foundation closely paralleling the ideological underpinnings of the modern infrastructural ideal. (Graham and Marvin, 2001)

For historian David Arnold, Nehruvian science 'created a space for postcolonial ownership and subjectivity … [contesting] Western presumptions of a monopoly over science' (Arnold, 2013b: 361). It imagined science as a *national* project, in service of the India's Cold War ambitions, but also as a program for sociocultural transformation, addressing social problems such as illness and poverty. (ibid: 365) For Nehruvians, science and its products would enable India to 'free itself from the incubus of custom and overcome deprivation and backwardness'; delivering rapid and far-reaching change without 'recourse to revolutionary violence or state authoritarianism.' (ibid: 366, 365)

4.3.c. 1991: Economic liberalisation

In July 1991, India's centre-left minority government introduced a raft of economic reforms intended to facilitate the country's transition to a 'more open and competitive market oriented economy' (Wadhva, 2000: 210). India, at this time, was on the brink of defaulting on its international debt repayments, a conspicuous failure of the promises of independence. (Kaur and Blom Hansen, 2016: 267) Citing pressure from global financial institutions, finance minister Dr Manmohan Singh imposed new limits on the state's involvement in certain sectors, while cutting tariffs and removing restrictions on foreign investment. (Münster and Strümpell, 2014: 1) Once an exemplar of state development planning, following the remarkable successes of the so-called 'Asian tigers' in sustaining economic growth through the 1960s–90s, there were growing internal calls for India to rethink its economic development strategy. (Wadhva, 2000: 207) Vulnerable to clientelism and rent-seeking, India's heavily regulated 'license-permit-raj' was widely believed to have perpetuated shortages and damaged economic competitiveness, thereby impeding growth. (ibid: 208)

Though widely accepted in popular discourse, whether or not the reforms of 1991 constituted a neoliberal threshold or temporal divide has remained an 'open question' for researchers, complicated by the unevenness, heterogeneity, and layerings that have shaped Indian society and economics. (Münster and Strümpell, 2014: 4) In settings where conditions and aspirations of freedom coexist with claims of race, religion and caste,

neoliberal calculations are often less preoccupied with 'norms of efficiency, transparency and accountability' than the cultivation of 'self-actualizing or self-enterprising subjects.' (Ong, 2007: 6) In India, in particular, contingencies in the localisation of neoliberalism have manifested through an unlikely conjuncture of neoliberal economics and a right-wing, majoritarian Hindutva politics—two distinct ideological projects, which, despite their temporal overlap and subsequent mutual enmeshments, were initially independent, 'not causatively linked.' (Oza, 2006: 2)

Perceived as having shed the 'cumbersome bureaucracy' blocking the emergence of a 'vibrant new economy that welcomed foreign investment' (Oza, 2006: 11), discourses of a 'new India' validated neoliberal ideas through declarations of rupture, while foregrounding new forms and relations of socio-economic interaction. (Neveling, 2014: 19) Public discourse focused on the rapid proliferation of 'shopping malls, multiplex cinemas, hi-tech call centres, new multi-lane toll highways, [and] world-class airports' (Kaur and Hansen, 2016: 271), and although the spaces and forms of this 'new India' were far-removed from the mass culture of India's poor majority, this 'restricted access' only reinforced their 'world class' value. (Kaur and Hansen, 2016: 271)

But just as many of the structures and systems of colonialism persisted beyond independence, discourses of a transformed nation served to obscure the layering of the new upon existing economic, political, and sociocultural structures. Far from a simple 'deus ex machina' (Neveling, 2014: 19), processes of market liberalisation, realised through government economic reforms, formed an 'untimely' interface with longer established 'postcolonial capitalist and Nehruvian developmentalist logics' (Münster and Strümpell, 2014: 2). Whatever the changes, India's 'strong and far-reaching Nehruvian state' did not immediately disappear, surviving, in many places, as a substrate that resisted erasure. (ibid: 8)

4.3.d. 'Good times': 2014 and Modi's India

India's 2014 general election, and the landslide victory of the right-wing, majoritarian BJP, under the leadership of Narendra Modi, elicited a range of anxieties around rising ethnic tensions, intolerance, and inequality—not just India, but around the world. As with the reforms of 1991, there was a temptation to treat this election as a singular rupture, critical turning point, and moment of realignment. But to what extent

was this justified? As Christophe Jaffrelot notes, the BJP's 2014 campaign was the first time a party's candidate for prime minister was a Chief Minister of one of India's states, able to canvas on their past record. (Jaffrelot, 2015a: 151) With Modi portraying himself as the '*Vikas Purush*' ('development man'), Gujarat was framed as laboratory and temporal prelude, mobilised as evidence that Modi 'would replicate at the national level what he had achieved in Gujarat in terms of development' (ibid.). References to the successes of the 'Gujarat model' proved popular, despite lagging progress on human and social development indicators, and economic statistics that concealed widening disparities—such that roughly a third of the population could be said to have been left behind. (Jaffrelot, 2015b: 821)

Writing in 2013, before campaigning began, Tomasso Bobbio described Modi as embodying an effort to reconcile tradition and modernity, playing 'the traditionalist Hindu leader who knows his way in the globalized world.' (Bobbio, 2013: 125) Similarly, Kavita Philip describes how Modi was depicted as India's 'futurist science and tech-booster leader', leading celebrations of India's Mangalyaan Mars mission, and making extensive use of social media. (Philip, in Greenspan et al., 2016: 262) Constrasting the 'Gujarat model' with other states' failings, Modi made much of this indigenised modernity in the 2014 campaign, establishing a tacit contrast with non-BJP Chief Ministers and the Congress Party's dynastic leadership, who, in failing to mediate the countervailing currents of tradition and globalisation, were depicted as responsible for the country's enduring socio-economic backwardness. (Jaffrelot, 2015a: 152)

Reflecting on Narendra Modi's victory, Ravinder Kaur considers how the slogan 'ache din' ('good times') has quickly become part of India's 'popular political vocabulary' (Kaur, 2015: 324). Connecting the 2014 BJP victory with India's economic liberalisation in the 1990s, she argues that widespread uptake of the 'vague but exhilarating' promise of 'good times' reflects a 'postreform consensus' in which capitalism has been 'reified as the sole vehicle of people's aspirations.' (ibid.) Capturing something of Indians' collective hopes and desires, and the perceived obstacles to their realisation, the vagueness of 'acche din' is a source of flexibility, allowing the slogan to be easily linked 'with specific goals or processes that are deemed as … long "held-back" aspirations of the common man.' (ibid: 324, 326) Even Modi's fiercest critics have been forced to engage with the discourse, appending 'acche din' with a question mark 'to ask whether a given negative condition is what the promise of good times was all about.' (ibid: 328)

This newfound emphasis on 'good times' is just one example of a new language that has emerged since 1991, privileging a new set of categories. (Hill, 2016: 259) *Development, governance, technological leaps, inclusive cities, smart cities, modern agriculture, Make in India, Swachh Bharat*—these terms and phrases, among others, conjured promises of a bright future, where infrastructure is a 'mechanism of both economic growth and inclusion' (ibid: 266). At the same time, such language elided the reality of continued structural unevenness in development and economic growth, something 'reinforced and perpetuated by a range of institutional, economic and political practices.' (ibid: 255)

4.4. Discussion

This chapter introduced my field site, the Gujarati city of Ahmedabad, working to situate the city in a broader geospatial, socioeconomic, and historical context. I began by describing the city's setting and early development, describing its most distinctive characteristics, including the *pol* typology and a sharp east-west divide. Addressing the city's socioeconomics and cultural politics, I reflected on the 2002 Gujarat pogrom, mobilising the 'urban laboratory' (Karvonen and van Heur, 2014) as a lens through which to examine the conjuncture of enduring social divisions amid rapid urban development and economic growth. Next, I discussed the challenges of reconciling a study of large, networked infrastructural forms with the strictures of a local field site. Reflecting on possible alternatives to the single-sited study (Marcus, 1995a; Blok, 2010), and recent work re-articulating the value of locally sited research in an era of global and transnational phenomena, I articulated my treatment of Ahmedabad as an 'equivocal location' from which to investigate the 'situated globalities' of infrastructure and urban change. (Heywood, 2015; Blok, 2010)

In the chapter's second half, I turned to history and the question of time, reflecting on various layerings of the city's past, present, and future. Focusing on the imbrication of colonial and postcolonial temporalities, I explored Ahmedabad and Gujarat's experience of British rule, before turning to the aftermath of Indian independence, when a national leadership worked to 'modernise' India through applied science and a planned economy. Following this with discussions of two moments that challenged the post-independence consensus, I jumped ahead to the 1990s, when the Indian government's moves towards deregulation opened the country to forces of neoliberalism and globalisation, while

spurring growth. Exploring the conjuncture of neoliberal economics and the growing influence of an assertive right-wing Hindu politics, I closed the chapter by looking at how these forces presaged the 2014 election victory of former Gujarat Chief Minister Narendra Modi.

Taken as a whole, this chapter showed the dominance of a temporal discourse equating development with order, juxtaposing an 'unruly and chaotic past against a future of possible plenty' (Desai and Roy, 2016: 11). Although the liberalisation of India's economy through the reforms of 1991, and, later, Modi's victory in the 2014 general election have, to some extent, moved India to a post-Nehruvian state, it is important to appreciate the continued presence and layering of colonial, Nehruvian, and neoliberal forces in mid-2010s Ahmedabad. By addressing these overlapping histories and temporalities, we might be able to move beyond accounts of linear progress or the restitutions of 'reform', embracing, instead, an understanding of the modern as moving 'in discontinuous fits and starts, with obstacles of various kinds scattered among its streams, and whorls and eddies disrupting the smoothness of a laminar flow.' (Pandian, 2012: 557)

Beset by neoliberal and Hindu nationalist challengers, Nehruvian visions of modernity have nonetheless proven highly resilient, providing the foundation for a popular understanding of 'development', in a Gujarati context, as an 'open-ended process … always improving the given in a busy race, with time to catch up to the 'foreign' places that Gujaratis en masse have departed for, or imagine themselves to be reaching one day —Bangalore, Sydney, London, New York, and suburban New Jersey.' (Ghassem-Fachandi, 2008: 86) As I move into the next chapter, which extends Walter Benjamin's figure of the *flâneur* (Benjamin, 1999) to the investigation of sociotechnical subjects in a postcolonial city, it is important to consider how *flânerie* can accommodate these layered temporalities, enduring but increasingly politicised conceptions of development and change, and Ahmedabad's distinctiveness as a site and setting for research.

Chapter 5: Sociotechnical flânerie in the postcolonial city

5.1. Introduction

This thesis builds on observations from ten months of field research in Ahmedabad, conducted across 2015–16. After introducing Ahmedabad and locating the city in a wider spatial and temporal-historical context, this chapter introduces the research methods underpinning my observations. Reflecting on their theoretical foundations and origins, I describe how I adapted these methods to better accommodate the contexts and subjects of my research, and how they shaped my subsequent writing and analysis.

In the first part of this chapter, I trace the mobilisation of the figure of the *flâneur*, and the practice of *flânerie*, from its origins in the streets and covered arcades of nineteenth-century Paris, to contemporary appearances at 'the periphery of the ethnographic disciplines' (Coates, 2017: 30). In the second section, I adapt the particulars of this mode of *flânerie* to the study of sociotechnical subjects. In part three, I transplant flânerie to the postcolonial city, a shift foregrounding the politics of mobility and observation, questions of researcher positionality, and how postcolonial relations shape discourse, representation, and the authorship of texts. Explaining the logic of these two translations, and their implications for *flânerie*'s component practices of *walking*, *observation*, *knowledge production*, and *textual authorship*, I describe which methods are easily translated, and which require more extensive reworking to accommodate new subjects and contexts of application (see Appendix 1).

Seeking to reconcile these mooted sociotechnical and postcolonial variants, I conclude by asking what it might mean to apply *flânerie* to the investigation of these phenomena—infrastructures and urban change—situating it in *this* location, and at *this* moment in time. Providing a foundation for the following chapters, which examine relations of mutability, mobility, and worlding, I show how the methods and component practices of this reworked *flânerie* can support relational, reflexive research, while remaining sensitive to the specificities of the field site; a postcolonial city in mid-2010s India.

5.2. The flâneur

Though the origins the *flâneur* are slippery, I identify the figure's recent popularisation with the 1999 publication of an English-language translation of Walter Benjamin's *The Arcades Project*, an incomplete collection of writings on city life in nineteenth-century Paris. Comprising a series of themed sectional 'convolutes' on everything from photography to the economic history of the Paris Stock Exchange, the work has been variously hailed as a 'creative way of underlining and categorizing the material and ideational contrasts of the nineteenth century' (Pusca, 2009: 241) and derided as 'the wreckage of a book that did not get written.' (Clark, 2000) Benjamin's attention wanders, but his text turns on the titular Parisian arcades as a recurring motif. An early shopping arcade, comprising pedestrianised covered passages, glass-ceilinged, and lined with small shops, these arcades were 'the site where the new Paris makes its debut' (Ferguson, 1994: 23); a 'microcosm that imitated and captured ... the major transformations on the nineteenth century' (Pusca, 2009: 245). These spaces gave material form to the changing relations of time and space under modernity—registering, among other things, the maturation of commodity capitalism, new technologies, urban development, and the resulting tides of social and cultural change.

The Arcades Project is still not that well-known. Outside of urban studies and work on visual culture, Benjamin remains a marginal scholar, his limited influence often attributed to the 'fragmentary nature' of his work. (Pusca, 2009: 239) Within urban studies and writings on modernity, however, *The Arcades Project* stands as a lodestone, 'endlessly [spinning] itself as source material for a variety of interpretive goals.' (Kramer and Short, 2011: 238-330) Taking Benjamin's work as a departure point for my own research, I use the figure of the *flâneur* to delineate a methodology grounded in practices of mobile observation. This has, however, required some modifications, reworking Benjamin's practices to better recognise Ahmedabad's status a postcolonial Indian city, and an 'equivocal location' (Heywood, 2015) from which to investigate infrastructure and urban change.

5.2.a. Origins of the flâneur

As articulated in Benjamin's writings on the French poet and essayist Charles Baudelaire (Benjamin, 1999; 2006), the *flâneur* was a social type new to the nineteenth-

century, encompassing writers, poets, and intellectuals. Identified as a 'solitary (male) loiterer' (Trivundža, 2011: 71) wandering the streets and arcades of Paris, this original *flâneur* was 'a consumer of—and later, a reporter on—the curious sites of the new commodity culture and associated urban crowd.' (Barker et al., 2013: 162-163)

Now long obsolete, his unhurried urban strollings eclipsed by the automobile, the *flâneur* has nonetheless endured, 'more visible in his afterlife than in his flourishing' (Buck-Morss, 1986: 105). A 'recurring motif' (Nuvolati, 2014: 21) and 'articulation point' (Trivundža, 2011: 72), the figure of the *flâneur*[27] unites a geo-historical phenomenon (the urban modernity of 19th-century Paris), an analytical concept (the untethered, mobile gaze), and a mode of investigation grounded in the pursuit of 'small epiphanies' (Trivundža, 2011: 75). In this, the question of whether the *flâneur* really existed, as depicted by Benjamin or Baudelaire, becomes less important than how, mobilised in contexts far beyond its historical origins, it can help illuminate 'relationships and forms of mediation between individual lives and wider social processes.' (Barker et al., 2013: 166)

5.2.b. Flânerie as research practice

The *flâneur* engages in *flânerie*, a way of reading the city, its population, and spatial configurations (Jenks and Neves, 2000: 1) through walking, observation, knowledge creation, and the authorship of texts. In this section, I introduce each of these component practices in turn.

Pedestrian mobility. The *flâneur* is, above all else, a figure of pedestrian mobility (cf. Coates, 2017). Free to traverse the city, solitary and unencumbered, he becomes part of the crowd, driven by its ebb and flow. (Trivundža, 2011: 75) Walking becomes a way to pursue 'body contact' with the city, combining sensory and analytical modes of engagement. (Nuvolati, 2014: 23) The *flâneur*'s strollings operate outside the constraints of organised time, an 'unhurried gait' masking his pursuit of urban energies, unforeseen novelties, and imbrications of the past and present. (Kramer and Short, 2011: 322)

Observation. As an observational method, *flânerie* relies on the 'dispersed attention' of a disengaged voyeur. (Van Leeuwen, 2019: 302) His fleeting gaze does not discriminate between subjects, assigning equal importance to the urban environment, its spatial

[27] As a figure, rather than a word or concept, the *flâneur's* 'semiotic boundaries blur', simultaneously embodying 'a kind of person, a kind of movement and a disposition towards the world.' (Coates, 2017: 29)

configuration, and the people and commodities that populate it. (Trivundža, 2011: 74) Operating as a 'kind of urban semiotician', the *flâneur* is attentive to details, cues, and signs 'normally overlooked by the fast-paced crowd' (ibid.). Simultaneously, as a participant in the crowd, he is particularly sensitive to the urban spectacle (cf. Debord, 1994), a category of visual phenomena rendered 'acceptably viewable', and typically benefiting 'the going order.' (Jenks and Neves, 2000: 9)

Knowledge production. *Flânerie* aims to make sense of a dynamic, fragmented urban experience. (Trivundža, 2011: 76) Relying on the 'scopic authority' of his own observations (ibid: 77), and moving easily between social settings, the *flâneur* is able to 'accumulate a massive amount of subjective, but nonetheless insightful ... data' (Bairner, 2006: 132). Faced with the challenge of translating this mass of observational data into knowledge, the *flâneur* draws on 'his gift of imagination' to make inferences. (Gluck, 2003: 70) Although the resultant findings are impressionistic rather than strictly realistic (Bairner, 2006: 127), the *flâneur* achieves rigour through triangulation, integrating his accounts with 'more scientific research concerning the city and its neighborhoods.' (Nuvolati, 2014: 25)

Authorship of texts. The practice of *flânerie* is usually a prelude to the creative production of literary texts. (Ferugson, 1994: 30) In his written outputs, the *flâneur* demonstrates a 'commitment to the representation of modern life' (Gluck, 2003: 62), working to depict the transformations and turbulence of Europe's fast-expanding cities. (Wilson, 1991: 54) These texts aspire to realism, combining socio-economic observations with a faithful representation of the world as encountered. Such outputs were not written for his own consumption, but produced with a popular readership in mind, capitalising on the discretionary spending of a newly literate urban middle class. (Trivundža, 2011: 78)

5.2.c. Flânerie and ethnography

The above delineation of the component practices of *flânerie* depicts an 'impermanent constellation' (Trivundža, 2011: 80). Since mobilised far beyond its geohistorical origins in the arcades of nineteenth-century Paris, *flânerie* has come to rest at the ethnographic periphery (Coates, 2017: 30), supporting research on, for example, disjunctures between the 'packaging' and lived experience of post-Troubles Belfast (Bairner, 2006); the collision of urban modernity and nomad mobilities in Ulaanbaatar

(Chisolm, 2009); and gender performativity in the organisational settings of the City of London. (Nash, 2018)

Elaborating on a 2000 article by Chris Jenks and Tiago Neves, sociologist Giampaolo Nuvolati (2014) indexes some key similarities and differences between ethnographer and *flâneur*. Motivated by a common desire to articulate unheard voices and 'empower through revelation', both use fieldwork and exploration to research the truth, authoring, through their written text, 'alternative discourses on social reality' (Nuvolati, 2014: 26). Both seek to render the familiar strange and the strange familiar; deploying techniques of estrangement, distancing, and defamiliarisation 'to make the reader conscious of difference' (Marcus and Fischer, 1986: 137). Adopting a 'peculiar pace', they move slowly, pushing against the strictures of utilitarian time, and sustaining a 'continuous reflexivity between perception and knowledge; experience and memory; sight and citation.' (Jenks and Neves, 2000: 4)

Articulating the differences between the two figures, Jenks and Neves point to the 'supposed frigidity and disengagement' of the *flâneur*, a distance contrasted with the ethnographer's 'greater proximity to the people studied' (Jenks and Neves, 2000: 4); and, as a consequence of such, distinct research strategies that, at their simplest, can be described 'as *voyeur* versus confidant' (ibid.). While the two figures pursue similar ends, there are also differences in the form, content, and audience of their authored texts. Crudely characterised, the *flâneur* is quicker to make use of 'poetic suggestions', while the ethnographer's texts face institutional and generic pressures to remain grounded in 'scientific description' (Nuvolati, 2014: 25).

5.3. Sociotechnical flânerie

In adapting and redirecting *flânerie* to the investigation of sociotechnical phenomena, I return to the term 'sociotechnical' as a source of productive friction[28], forcing an acknowledgement of the co-imbrication of technology and society, and slowing those who would enter the field, archive, or city looking for 'discrete entities' rather than 'seamless webs' (Hughes, 1986: 291). Borrowing freely from the methods and approaches of contemporary STS, this variant of sociotechnical *flânerie* is similarly slowed and sensitised, inflected with the quiddities of a field united by a shared sense that science,

[28] See Chapter 2; pp. 15–16.

technology, and society are 'made in the doing', both within institutions and 'across wider terrains ... wherever people are engaged in creating knowledge and rearranging materiality.' (Felt et al., 2017: 21-22)

Approaching the urban transformations and turbulence that formed the backdrop to *The Arcades Project* as precisely the kind of material rearrangements taken up elsewhere in STS, today's sociotechnical *flâneur* is transplanted from the Paris arcades to the contemporary city's 'suburbs and commercial malls' (Nuvolati, 2014: 22)—or other 'equivocal locations' (Heywood, 2015) capable of illuminating 'the local articulation of multiple, often incommensurable ways of enacting the city' (Farías and Blok, 2017: 574). However relocated, this *flâneur*'s motivation remains the same; 'to observe … and to produce descriptions that are useful ... in perceiving and interpreting the city.' (Nuvolati, 2014: 24) His activities, like those of his predecessors, constitute an attempt to 'narrate the connections', enabling the 'conception of a city simultaneously in terms of its parts and as a whole.' (Ferguson, 1994: 39)

5.3.a. Flânerie as sociotechnical investigation

Revisiting *flânerie*'s component practices of walking, observation, knowledge creation, and the production of texts, here, I expand on how a more explicitly sociotechnical *flânerie*, slowed and sensitised to the infrastructures and material rearrangements of the contemporary city, might deviate from that described by Walter Benjamin and his later interlocutors.

Pedestrian mobility. Today's *flâneur* supplements his strollings with journeys by public transport, using his status as a passenger to observe the design and workings of the city's infrastructural systems. (cf. Angelo and Hentchel, 2015) Aware of his own conditions of movement, he registers the presence of other mobilities and mobile bodies, quotidian and spectacular alike. Travelling by car may deprive him of opportunities for contact with the city and its inhabitants, but 'inside the bus, the train or ... the black taxi, people speak and act at normal speed' (Bairner, 2006: 127). Moving through the city's spaces as part of a crowd (cf. Shields, 1994), he is also, increasingly, an audience member and potential user of technology, addressed by the media, systems, and artifacts that facilitate city life. These interpellations make it harder to sustain a social distance and disengagement from his subjects of investigation. Salient, too, is *flânerie*'s status as *embodied* research; the *flâneur*

still seeks direct engagement with the material world, 'botanizing on the asphalt' (Benjamin, 2006: 68), but, guided by the concerns of STS, his body contact with the city becomes an 'opportunity to ruminate' on his research subjects. (Karvonen, 2008: 78) Free to linger and reflect, the *flâneur*'s 'peculiar pace' (Jenks and Neves, 2000: 4) reflects his position in the ethnographic periphery of academic or private-sector research (Coates, 2017); something allowing for the longer, more sustained durations of fieldwork.

Observation. In shifting to an investigative mode of research, the *flâneur* demonstrates a more purposive attention and greater engagement, allowing himself to become 'implicated in the relations between the city's residents and their material surroundings' (Karvonen, 2008: 76). His roving eye still sweeps the surfaces of the urban environment but, in moving closer to his objects of study, he is less easily tarred as a voyeur. Attuned to the concerns of STS, the *flâneur* expands his focus, supplementing his observations of urban spaces, people, and commodities with a newfound attention to objects, infrastructures, and technological artifacts; and considering how these register dynamics of change. (Pusca, 2008; 2009) His observations balance, first, a focus on traces, signs, and quotidian details, and their hidden meanings; second, a forensic interest in urban and technological spectacles, reading media and events for authoritative representations; and third, forms of *flânerie* drawing on 'interface ethnography', operating in those 'border areas' where otherwise closed communities and institutions 'interface' with the wider public. (Ortner, 2010: 213)

Knowledge production. Addressing the sociotechnical and material dimensions of a fragmented urban experience, this updated *flâneur* uses his mobile observations to 'grapple with the city in relational terms' (Karvonen, 2008: 80). Shedding his aloofness, he instead pursues a 'polymorphous engagement' with his subjects of investigation; supplementing mobile observations with other techniques, including formal interviews, close reading, and forms of media and cultural analysis. (Gusterson, 1997: 116) In mapping and interpreting correlations derived from his observations, any pretence of *knowing* the city must be discarded. (Amin, 2013: 206) The *flâneur* instead settles for a mode of research better 'accustomed to working with partial and adjusted insights' (ibid.), following anthropologist David Zeitlyn in aspiring to produce 'faithful accounts' of an uncertain, dynamic, and often recalcitrant world. (Zeitlyn, 2009) Taking steps to acknowledge and mitigate the partiality of these accounts through practices of reflexivity, disclosure, and triangulation (Zeitlyn, 2009: 212), he also works to situate his findings through comparison and appeals to theory. (cf. Candea, 2016; 2019)

Authorship of texts. In producing faithful accounts of infrastructural systems and urban transformation, practices of 'thick description' furnish the context required for interpretation. (Geertz, 1973) Such forms of writing provide ways to depict and grasp a slippery 'multiplicity of complex conceptual structures ... at once strange, irregular, and inexplicit' (Geertz, 1973: 10), and exceeding that immediately accessible to the roving eye. By addressing such texts to an academic audience, rather than a popular readership, this reworked *flâneur* is challenged to validate the credibility of his research; work that might otherwise be tarred as overly 'poetic', constituting little more than a 'gloating over local detail' (Clark, 2000). Pre-empting this line of criticism, Andrew Karvonen limits his use of *flânerie* to work in a supplementary mode, complementing case studies derived from interview materials and textual analysis. (Karvonen, 2008) The would-be sociotechnical *flâneur* might also respond by making more extensive use of comparative analysis (cf. Boyer and Marcus, 2015; Candea, 2016; 2019; Deville et al, 2016; Krause, 2016); building theory and deriving insights by thinking 'across case studies, finding the transparticular linkages and resonances' that lend greater weight to his own mobile observations. (Boyer and Marcus, 2015: 7)

5.3.b. Turning flânerie to infrastructure and sociotechnical change

In turning this updated sociotechnical *flânerie* to the investigation of infrastructure and urban change, is important to recognise that the Parisian *flâneur* of the 1850s was himself reacting to Baron Haussmann's monumental reconfigurations; the presence of a 'big urban master plan' that 'radically changed the urban fabric of the French capital.' (Gatta and Palumbo, 2014: 245, note 1) Finding themselves in the passages and boulevards of the Paris of a new regime and century (cf. Ferguson, 1994), but seeking to move beyond the pomp and spectacle of the 'official', public city under construction, the *flâneur* instead focused on the 'trivial, fragmented aspects of street life' (Wilson, 1991: 5), juxtaposing this 'official' city with observations made 'botanizing on the asphalt' (Benjamin, 2006: 68).

Seeking reference points for this updated sociotechnical *flânerie*, I found possible precedents in work on objects as markers of post-socialist transitions in Albania and the Czech Republic (Pusca, 2008; 2009), the politics of urban drainage in Austin and Seattle (Karvonen, 2008), the urban transformations of northeast Paris (Gatta and Paumbo, 2014), and the quotidian experiences of a housing association president. (Pinch, 2010) In

these works, we can see how the sociotechnical *flâneur* might pursue *flânerie* as a heuristic device for 'conducting observations on the ground' (Gatta and Palumbo, 2014: 246) and an 'opportunity to ruminate' on otherwise slippery or elusive subjects of inquiry. (Karvonen, 2008) Engaging a more purposive mode of attention, he might focus on how material objects and infrastructures register 'processes of becoming and disappearance' (Pusca, 2009: 249), while continuing to ground his analysis in 'faithful accounts' of first-hand experiences, derived from subjective, partial data. (Zeitlyn, 2009)

5.4. Provincialising methods: Flânerie in the postcolonial city

In transplanting this already-reworked sociotechnical *flânerie* to the city of Ahmedabad, this section addresses some of the ways a postcolonial field site might complicate the practice of *flânerie* outlined above, demanding further modifications. Having already discussed the *flâneur*'s origins as a product of nineteenth-century Paris, these further adaptations build on efforts within postcolonial theory to 'provincialise Europe', acknowledging the situated, parochial, and overwhelmingly *Euro-American* origins of commonly-used methods and dominant, universalising theoretical approaches. (cf. Chakrabarty, 2008; Law and Lin, 2017) At its simplest, this requires acknowledging that 'how to think with/in the world—*this* time, on *this* occasion, under *these* circumstances—is never settled in advanced, but must be worked out' (McCormack, 2015: 89). Which of the practices and techniques introduced above can be reproduced in the postcolonial city, and which must be retooled to better suit this new context of application?

Reviewing Benjamin's then still newly translated *Arcades Project*, postcolonial scholar Rajiv Patke claimed Benjamin's work was sufficiently flexible to accommodate the postcolonial; arguing the 'set of approaches [Benjamin] uncovered continue to remain valid wherever the project of modernity is at work.' (Patke, 2000: 3) Although there are parallels between the European cities experienced by Benjamin and my own strollings in mid-2010s Ahmedabad, claims regarding the determining factor of modernity risk obscuring clear and significant differences between the two.

Postcolonial cities are Janus-faced, having served both colonisers and colonised, with histories of separating and subjectifying their populations through spatialised practices of 'surveillance, policing, hygiene and controlled social interaction' (Varma,

2012: 10). Today, such cities are constituted by 'tensions and contradictions' between global, national, and local concepts and practices. (ibid: 14) Moulded by conjunctures of 'historical events, material bodies, structural forces and representational economies' (ibid: 1), these cities are settings where clear-cut ideas of centre and periphery are 'scattered, twisted and reconstituted by contestations with, and transformations of, the imperial project' (ibid: 5). In this much, my relocation of *flânerie* requires a careful attention to the 'conjunctural' spaces of the postcolonial city, a setting shaped and striated by colonial rule. (Varma, 2012)

My reworking of *flânerie* starts by provincialising pedestrian mobility and the dispersed attentions of Benjamin's disengaged voyeur, foregrounding their European origins and the limits of their application. Relocated to urban India, the *flâneur* becomes an auto-rickshaw passenger, finding places to stop and 'perch', while engaging with contingent communities of proximity and practice. Registering the details, signs, and material traces of the postcolonial city becomes a way to apprehend the aftermaths of colonial rule. Producing knowledge and authoring texts, he supplements his mobile observations with practices of reflexivity and disclosure, attending closely to his own implication in processes of subjectification, and how race and gender mediate his body contact with the city. Blending literary accounts, reportage, and ethnographic description, his writing draws on 'non-Western analytic resources' (Law and Lin, 2017) in deconstructing colonial tropes and engaging with the contested politics of representation.

5.4.a. Situating mobilities: by auto-rickshaw and on foot

In the contemporary Indian city, the otherwise free-roaming *flâneur* is confronted with a mobility system encompassing cars, buses, trains, and motorcycles[29]—but also tractors, pedal rickshaws, camel carts, bullock carts, and auto-rickshaws. (Wilson, 2013: 68) Ahmedabad's pattern of high-density, mixed land use encourages walking and cycling, even in the absence of pavements or cycle paths, and with a recent boom in motorbike and car ownership further reducing the space available for non-motorised transport. (Wilson, 2013: 72) Stumbling on Ulaanbaatar's 'crumbling curb', before the onslaught of 'multi-horse-powered land cruisers', self-confessed 'metropolitan foreigner' Diane Chisholm was quick to trade the *flâneuse*'s pedestrian mobility for jeep taxis and, later, a pinto gelding and herder. (Chisholm, 2009) In much the same way, seeking to traverse the Indian city,

[29] Known locally as *two-wheelers.*

the relocated *flâneur* yields to the local mobility regime, and flags down an auto-rickshaw.

The auto-rickshaw may not be the most prevalent mode of transport in the Indian city, but it is emblematic of its setting, freighted with local cultural meaning. Like the *flâneur*, the auto-rickshaw passenger is a figure of mobility; a concept-metaphor sensitising the reader to situated pedestrian and vehicular mobilities. (Salazar, 2017; Coates, 2017) Just as Chisholm, having mounted her Mongolian pinto, found herself to be but one component in assemblage 'part horse, part saddlery, part grasslands, and part sky' (Chisholm, 2009: 43), upon entering the auto-rickshaw, the *flâneur* is thrown into a sociotechnical ensemble comprising driver, wheels, chassis frame, roof, handlebar controls, mandatory fare meter (typically deactivated), natural gas engine, radio, and, in one memorable case, a small, roof-mounted model eagle and string of green LEDs.[30]

Neither public nor private, the auto-rickshaw bridges the gap between pedestrian mobility, public transport, and the private automobile. Although their business is contingent on the auto service being 'available to all those who can pay', drivers exercise a 'tenuous proprietorial control' over vehicles they may rent or own outright. (Chowdhury, 2018: 91) Stigmatised as *auto rackshasha*[31], and portrayed as greedy and prone to overcharging, their very existence is seen as contributing to traffic congestion and air pollution. (Harding et al., 2016: 144) Today, drivers face competition from new market entrants, such as Ola and Uber; firms using digital platforms and smartphone technology to connect passengers with drivers of cars or small vans; vehicles which, unlike auto-rickshaws, are shielded from dust, weather, and exhaust fumes, and often air-conditioned. (ibid: 150)

The auto-rickshaw's 'three-wheeled angularity' makes it unstable[32], but also *nimble*, enabling drivers to manoeuvre through gaps on traffic-heavy roads (Chowdhury, 2018: 98), and, in Ahmedabad, penetrate the narrow streets and *pols* of the historic walled city. A form of 'paratransit', the auto-rickshaw provides flexible and frequent 'contract carriage' services. (Shimazaki and Rahman, 1996) Upon entering the vehicle, the *flâneur* must be able to set his destination; a condition with implications for his experience of the city, and the mobile observations that underpin his research. While auto-rickshaw travel may supplant many of his wanderings on foot, upon disembarking from the vehicle, the *flâneur* must also contend with how his pedestrian mobility is re-contextualised in and by the

[30] From field notes, 24 April 2015.
[31] 'Auto demons' or 'devils'.
[32] Liable to 'turn turtle' if shunted, bumped, or abruptly cornered. (Harding et al., 2016: 145)

postcolonial city; mediated by his embodied subject position, and a variety of urban rhythms, velocities, and temporalities.

The figure of the *flâneur* is gendered, classed, and raced. Marked by his origins in the European metropole, his peripatetic observations were, originally, those of 'an aristocratic white male with a lot of leisure time.' (Van Leeuwen, 2019: 307) Much has been written on the gendering of the *flâneur* as a masculinist subject, operating from a position of privilege and personal safety.[33] (cf. Wilson, 1992; 2001; Chisholm, 2009) Operating in the sociotechnical mode, the *flâneur*'s body may be present in his texts, as a research instrument enabling his mobile observations, but the mediating effects of his subject position are rarely addressed, beyond shallow gestures of reflexivity. (cf. McLaren, 2016) Relocated to the postcolonial city, these effects proliferate, rendering the workings of race, gender, and class more directly perceptible. Marked as a stranger, his body and subject position shape his experience in innumerable ways; affecting his freedom to walk in the city, the places he can access, his treatment by others, modes of observation, and, ultimately, the kinds of knowledge and texts he can produce.

Estranged from the crowds and audiences of the postcolonial city, his body out of place, the relocated *flâneur* finds solace in communities of proximity and practice; in my case, not just as a member of a geographically distributed research community, but an active participant in photo-walks and tour groups, and member of a local coworking space. Through sustained engagement, these contingent communities function as 'micro-publics' (Amin, 2002: 969), constituting 'spaces of association … in which dialogue, debate and prosaic negotiations are compulsory' (Van Leeuwen, 2019: 310). Providing the *flâneur* with opportunities to engage strangers in a common activity, such spaces are seedbeds for cosmopolitan citizenship (Van Leeuwen, 2019: 310-311), disrupting otherings of the unfamiliar, initiating new attachments, and offering participants the 'chance to break out of fixed relations and fixed notions' (Amin, 2002: 970).

Rejecting a purely cerebral engagement with the city's material environments, this relocated *flâneur* asserts the value of sensory and corporeal experience, pursuing 'body contact' as a way to apprehend patterns of difference. (Verran, 2001; Nuvolati, 2014) Open to the world, the researcher's body is not just a perceptive or sensory instrument, but also a barometer, registering the flickering 'forces and intensities' of atmospheres, emotion, and bodily disconcertment. (Seigworth and Gregg, 2010: 1) Though he continues to

[33] Even as 'financial insecurity and emotional ambiguity' undermined the solidity of his 'embodiment of male bourgeois power.' (Wilson, 2001: 86-87)

foreground the practice and products of his mobile, embodied observations, this *flâneur* also admits the significance of such 'visceral forces' moving 'beneath, alongside, or generally *other than* conscious knowing' (ibid.).

By turns racing around or held up in traffic, the relocated *flâneur* assumes *multiple velocities* within the sustained durations of fieldwork, his movements reflecting how, in India, the diffusion of linear clock time competed with 'older, cyclical experiences of time' (Jeffrey, 2017b: 408). He works to balance the leisurely pace of *flânerie* with participation in utilitarian time, shuttling between hotels and guest accommodation, participating in seasonal festivals, and rushing to capture time-limited events. He might find himself stuck in traffic, or resorting to *timepass*; an Indian English term denoting 'relatively meaningless, light, trivial activity', those distractions deferring boredom during periods of downtime, while waiting, or 'between bouts of work' (Jeffrey, 2017b: 407).

5.4.b. Situating observation

Extending his mobile observations to the postcolonial city, the relocated *flâneur* encounters a setting where the act of looking has long been a tool of authority, caught up in practices of surveillance, and structured by 'radically asymmetrical relations of power' (Pratt, 2008: 8). Exploring the ways imperial and postcolonial *travel writing*, in particular, presented the world for European readerships, Mary Louise Pratt refers to the 'seeing-man', an 'admittedly unfriendly label for the white male subject', whose 'imperial eyes' conflated the act of looking with sovereignty and possession. (ibid: 9) The relocated *flâneur* strives to avoid identification with Pratt's 'seeing-man.' Holding observational methods as the central plank of his investigations into urban and sociotechnical phenomena, but newly stimulated by an unfamiliar milieu, he proves incapable of sustaining the more directed, purposive attention of his sociotechnical analogue—something he tries to mitigate by showing, where appropriate, a greater reflexivity towards his allocation and modes of attention.

The observational practices of this relocated *flâneur* demonstrate clear continuities with those of his predecessors. He is, by turns, an attentive observer of the sociotechnical, and a voyeur enthralled by postcolonial difference. Further to these modes of spectatorship, there is also, perhaps, a greater desire to put *flânerie* to work, in service of ethical or normative commitments, something contingent on a shift from detached, mobile

observations of 'the other' to 'more meaningful modes of interaction.' (Van Leeuwen, 2019: 302) Already a *cultural cosmopolitan*, taking pleasure in the diverse stimulations of urban space, this relocated *flâneur* could easily be taken for a global nomad, skimming the surface of any number of self-described 'world cities', and navigating 'the fractures of global society and urban polarization' (Kramer and Short, 2011: 338). As Diane Chisholm notes, such a figure would delight in global travel, boosting his social and venture capital 'by becoming streetwise in emerging market centers, especially those of "developing" nations with novel technologies of urban self-aggrandizement.' (Chisholm, 2009: 29-30)

Reflecting a broader critique, which tars *flânerie* as dilettantish, opportunistic, or superficial, Bart van Leeuwen claims such comments overlook the relationship between the *flâneur*'s urban context, his 'existential interest in socio-cultural difference', and a drive to develop a 'more encompassing moral sense and commitment.' (Van Leeuwen, 2019: 309) Through encounters with the strange and unfamiliar, and contact with communities of proximity and practice, this *flâneur* aspires to establish a 'subject-subject relationship' grounded in more than the 'sheer observation of otherness, ... difference and the unknown' (ibid: 310-311). Reaching towards moral cosmopolitanism, but often falling short of the practical actions it requires, his observational practices are thereby caught between fleeting voyeurism, engaged observation, and his own ethical or normative commitments.

5.4.c. Situating knowledges: reflexivity and disclosure

Further inflecting the modes of knowledge production engaged by his earlier counterparts, this relocated *flâneur* supplements his scopic observations and 'polymorphous engagements' (Gusterson, 1997) with more extensive practices of reflexivity and disclosure. With the *flâneur*'s 'declared subjectivity' explicitly constituting a standpoint 'from which to confront and analyze reality' (Nuvolati, 2014: 24), there has been, for me, a pressing need to recognise the impacts of this on the trajectory and outputs of my research. Such moves often trigger anxiety and ambivalence, with few clear answers about how much to show of the otherwise obscured 'assumptions, motivations, narratives, and relations' which comprise the 'backstage' of qualitative research. (McCorkel and Myers, 2003: 200) Jill McCorkel and Kristen Myers, for example, prescribe a 'thorough ... examination of the context of discovery' (McCorkel and Myers, 2003: 200), requiring the researcher to lay 'her taken-for-granted assumptions, beliefs, and stereotypes on the table

for dissection.' (ibid: 205)

Stressing the extent which researchers may struggle with uncertainty, contingency, and imperfect knowledge, Gillian Rose argues that efforts to achieve a pure, 'transparent' reflexivity are difficult, if not impossible. (Rose, 1997) As such, the would-be *flâneur* should seek to move beyond treatments of bias and subjectivity as 'ghosts we are trained to ritualistically bury at the start of our research' (McCorkel and Myers, 2003: 200). Turning to the effects of their role and identities in 'mediating' their research, it makes sense to attend to their 'institutional scaffolding' and researcher-subject relationships, and the different ways these relations influence their positioning and research vision. (McCorkel and Myers, 2003: 213) To consider *how*, I turn to Gyatri Spivak and Ilan Kapoor's writings on subaltern subjects and the charged politics of representation (Spivak, 1988; 1993; 1999; Kapoor, 2004), and Peter McLaren's treatment of reflexivity. (McLaren, 2016) These texts highlight three key elements of reflexivity and disclosure.

Firstly, the *flâneur* must contend with their 'site of enunciation' (McLaren, 2016: 82), deconstructing and critiquing the familiar, often seductive 'things in which one is most intimately mired' (Spivak, 1990: 135). Disclosing the various ways our 'personal and institutional desires and interests are unavoidably written into our representations' becomes a necessary precondition for being able negotiate from *within*. (Kapoor, 2004: 641) Secondly, they must abandon the 'ventriloquistic illusions of speaking from where one is not' (McLaren, 2016: 82). Always already located 'inside discourse, culture, institutions, geopolitics', acknowledging their mediating effects allows the *flâneur* to 'temper and contextualise' their claims, enabling more responsible modes of engagement. (Kapoor, 2004: 640) Third, they must turn their gaze on their own 'local terrains of identity formation' (McLaren, 2016: 83), something that entails retracing 'prejudices and learned habits' and, in some cases, working to 'unlearn dominant systems of knowledge and representation.' (Kapoor, 2004: 641)

Throughout, it is important to acknowledge that situated knowledges may be unreachable or inadequate to the requirements of the research. The ritualistically buried ghosts of bias and subjectivity may not remain so. With the risks of research impossible to know in advance, reflexive practices must recognise that we are 'working without guarantees', and that our research subjects may exceed our understanding or expectations, or else fall our representational blind spots. (Kapoor, 2004: 644) This requires accepting the silence of the subaltern, 'its refusal to answer or submit to the gaze

and questioning of the ethnographer [or *flâneur*].' (ibid.)

Situated knowledges are also *provincialised* knowledges, defamiliarising and unpicking the universalisation of Euro-American concepts, histories, and norms. (cf. Chakrabarty, 2008; Law and Lin, 2017) Abandoning the disembodied 'view from nowhere' (Haraway, 1988) having addressed his own sites of enunciation and identity formation, the relocated *flâneur* follows John Law and Wen-yuan Lin, who advocate for 'forms of postcolonial investigation that use non-Western analytical resources.' (Law and Lin, 2017: 212) Setting non-Western terms of analysis alongside, for example, Euro-American theoretical accounts of infrastructure and urban change allows a 'lively, two-way, and contested' traffic between the two. (Law and Lin, 2017: 214)

In practices of knowledge production and writing, the call for situated and provincialised knowledges might therefore require a greater attention to emic and local terms, but also to moments of disconcertment (Verran, 2001), explanatory logics (Law and Lin, 2017), and lateral concepts (Boyer and Howe, 2015; Gad and Jensen, 2016a; 2016b), such as Indians' vernacular use of English-language 'keywords' to grapple with modernity. (Jeffrey, 2017a: 273) It might also entail a sustained engagement with outliers and anomalous observations, the leftovers of fieldwork. (Carabelli, 2014: 193) Such materials can provide handles, sites, or staging posts from which to 'unravel the journey that shaped the research process and the ways in which it came to be presented to the reader.' (Carabelli, 2014: 192) In rendering the backstage visible, however briefly, these disconcertments and leftovers map a fragmented and asymmetric research space —'webbed across gaps in understandings, saturated with power, but also ... uncertainty' (Rose, 1997: 317). Such a terrain requires vigilance, a register echoed by Gyatri Spivak, for whom reflexivity and disclosure reflect a requirement to take responsibility, to be held accountable for one's claims, as a foundation and prerequisite for ethical engagement. (Spivak, 1994)

5.4.d. Situating texts

Inspired by the writings of his predecessors, the relocated *flâneur*'s outputs blend literary accounts, reportage, and ethnographic description, while engaging with questions around the limits and politics of representation (Spivak, 1988; Kapoor, 2004), and working to delineate and deconstruct colonial tropes and orientalising stereotypes. (cf.

Said, 1979; Spurr, 1993; Bhabha, 1994; Huddart, 2006; Pratt, 2008) Writing for an audience that extends the sociotechnical *flâneur*'s community of research practice, he also bears a responsibility to his interlocutors, who are often members of micro-publics (Amin, 2002), or other communities of proximity or practice.

Translating his mobile observations into written outputs, this relocated *flâneur* must grapple with the lively afterlife of tropes, conventions, and stereotypes from colonial discourse, which continue to position subjects and generate meanings. (Pratt, 2008: 238) Closely associated with Orientalism, the institutionalisation of knowledge about the societies and peoples of Asia, North Africa, and the Middle East, these discursive features track the techniques Western writers used to construct a 'coherent representation out of the strange and (to the writer) often incomprehensible realities confronted in the non-Western world' (Spurr, 1993: 3). Orientalism presented a vision founded on difference, identifying the European as familiar and knowable, while the Orient stood as a 'reservoir of infinite peculiarity' and 'living tableau of queerness' (Said, 1979: 103).

Through these tropes, conventions, and stereotypes, the colonised subject is produced as 'other', but 'entirely knowable and visible.' (Bhabha, 1994: 70-71) A tool of colonial authority, stereotypes of the 'noble savage' or 'inscrutable Oriental' stand as assertions of 'rigidity and an unchanging order', shuttling between that which is 'in place' and that which demands repetition. (ibid: 66) Colonial discourse derives its authority from the simultaneous recognition and disavowal of racial, cultural and historical distinctions; fixing and essentialising the differences between colonisers and the colonised, even as differences *within* these groups are elided, or erased altogether. (ibid: 70) The ambivalence and anxieties that propel stereotypes' repeatability can be productive for those, such as our relocated *flâneur*, intending to 'write against' colonialism. Seeing how such stereotypes are solutions to particular problems, he is urged to approach each as a 'singular instance' rather than part of a wider pattern; its gradations of difference making its effects perceptible, and facilitating an analysis of the operations of discursive power. (Huddart, 2006: 26)

These orientalising, stereotypic features of discourse are most perceptible in certain forms and genres, including journalism, narratives of travel and exploration, and colonial memoirs. Examining a corpus of such texts, David Spurr describes a set of rhetorical modes engaged, unselfconsciously, by those writing about non-Western places and peoples. (Spurr, 1993: 3) Clumping and flagging those most relevant to my own research, I

limit my discussion to five such modes, delineating rhetorics of *observation*, *uplift*, *classification*, *denigration*, and *admiration*:

- ***'observation'*** denotes those modes of writing that enshrine a clear division between the observer and the objects of his gaze (Spurr, 1993: 15); held safely 'at arm's length', colonised peoples and places are aestheticized, becoming an 'object of beauty, horror, pleasure, and pity' (ibid: 59).
- a rhetoric of ***'uplift'*** supposes colonised subjects are 'improved and edified' by colonialism (Spurr, 1993: 33); celebrating the 'unifying power' of Western institutions, and invoking a 'collective subjectivity' operating 'in the name of civilization, humanity, science, progress, etc.' (ibid: 110)
- ***'classification'*** mirrors Edward Said's discussion of delineations of the Oriental and the European, describing the ways countries and peoples are divided into the developed and the underdeveloped, the civilised and the savage, etc. (Said, 1979); with a 'hierarchy of political configurations' plotted 'along a single line of development' (Spurr, 1993: 62; cf. Rostow, 1960).
- a rhetoric of ***'denigration'*** constructs the Other as abject, empty, or insubstantial; the colonised subject is either emblematic of a degradation inhering to their culture and society, a blank or 'ambiguous object' erased to clear space for colonial expansion (Spurr, 1993: 92), or part of a 'backdrop of baseless fabric', set-dressing for the Western writer's subjective interiority and personal dramas. (ibid: 142)
- cnversely, ***'admiration'*** casts the Other as pure, unspoilt, courageous, spiritually transcendent, or 'part of the natural world' (Spurr, 1993: 157), a 'noble savage' existing pre-culture, in a space 'outside of time' (ibid: 127).

Writing *against* these tropes, Spurr struggles to reconcile the imperative of critical self-examination with the stated aim of authoring faithful accounts of a 'world that lies outside of Western subjectivity.' (Spurr, 1993: 189) Even those practices of reflexivity and disclosure, described above, reproduce a 'displaced version of monologic authority', steeped in Western modes of subjectivity, which remains 'powerful enough to absorb a certain amount of interference.' (ibid: 195) How, then, to proceed? As Spurr asks: 'do the possibilities for written description and representation of other cultures extend beyond the theoretical space occupied by the Western discourses of power?' (ibid: 188)

Reflecting on the representational challenges facing the relocated *flâneur*, I find a second reference point, more relevant to the Indian city, in a corpus of literary nonfiction

produced by second- and third-generation Indian 'returnees'. (cf. Srinivasan, 2015; 2016; Mendes and Lau, 2019) At once responding and contributing to a 'rhetoric of India's rise' (Srinivasan, 2015: 309), these *city-books* provide a 'narrative triangulation' between their authors' return journey, the emergence of a dynamic 'new' India, and first-hand encounters with other, more locally rooted Indian subjects, whose 'itineraries illuminate the nation's experiments with globality in ways otherwise unavailable to the diaspora-returned.' (Srinivasan, 2016: 95) Blending on-site observations, analysis of cultural landscapes, and reflections on the authors' own emotional responses (Mendes and Lau, 2019: 58), these works constitute a 'literature of reckoning' (Srinivasan, 2015: 311). Their writers perform a 'profane pilgrimage' to the 'unholy sites of New India's increasingly unequal and stratified cities', motivated by the diasporic subject's drive to 'participate in a world-historical moment that ... exceeds the self.' (Srinivasan, 2015: 311)

This urban 'return-writing' struggles with much the same representational challenges as those encountered by Benjamin and Baudelaire's original *flâneur*. Striving to apprehend and write 'the present that is India under ... globalisation', these authors struggle with an unwitting coupling of the 'constitutive unruliness of the contemporary' and their own 'perspectival blinders of personal enmeshment.' (Srinivasan, 2016: 95-96) The return-writer may be seeking greater proximity to 'the Indian life he might have lived' (ibid: 109), but his attempted return is contingent on the ease and comforts of the global city. Reflecting on the limits of representations 'issued from a conjunctural 'new India' ... [of] business class lounges, five-star hotel suites, and luxury malls', Ana Christina Mendes and Lisa Lau describe how these city-books are shaped by their conditions of production Mendes and Lau, 2019: 59); supported by Western publishers, and appealing to a self-consciously 'global' readership, who see Orient and Occident in 'relative rather than absolute terms.' (ibid: 64)

With the West as his hinterland or terrain of identity formation, the return-writer comes to resemble Chisholm's maligned 'global flâneur':

> Once the inner-city's arch non-conformist, the flâneur now sets the standard for inter-city cruising. A man-about-the-megalopolis, he delights in global travel and he boosts his venture capital by becoming streetwise in emerging market centers, especially those of "developing" nations with novel technologies of urban self-aggrandizement. (Chisholm, 2009: 29)

Confronted with the representational challenges posed by the turbulence and transformations of his urban subject matter, this return-writer passes the 'proverbial baton of informancy' to local figures whose lives 'better parallel that of India's ascent.'

(Srinivasan, 2016: 96) Supplementing his first hand-observations and analysis of 'new' India's cultural landscapes with 'portraits and micro-biographies' (ibid.), they are prone to fall back on their 'prisms of social and economic privilege and re-orientalistic discourse' (Mendes and Lau, 2019: 69), unwittingly iterating on the kinds of stereotypes and rhetorics identified above.

Comparing David Pratt's selection of nineteenth- and twentieth-century journalism, colonial memoirs, and travel narratives (Pratt, 2008) with this more recent corpus of Indian *city-books*, we can see how both sets of texts promise a 'direct response to the experience of a specific cultural or historical actuality' (Spurr, 1993: 189). As such, any analysis or deconstruction that makes recourse to 'unqualified realism' is 'far too similar to its object' (Huddart, 2006: 27). Rather than analysing such narratives where they fall short, we need attend to those areas where they exceed the subjects they purport to represent—as in the stereotype—opening 'directly onto the *fractures and contradictions* of colonial epistemology.' (Spurr, 1993: 2; emphasis mine) In deconstructing and unpicking such discourses, we therefore require 'narrative strategies that can capture its bizarre or unrealistic qualities.' (Huddart, 2006: 27)

For the relocated *flâneur*, the lively afterlives of these features of colonial discourse illuminate the politics and performativity inherent in practices of representation. Writing against colonial discourses that fix or arrest difference, he borrows from non-representational theory. A synthesising effort with its origins in cultural geography, non-representational theory brings together a range of work seeking to better accommodate 'our self-evidently more-than-human, more-than-textual, multisensual worlds.' (Lorimer, 2005: 83) Phillip Vannini (2015a; 2015b; 2015c) has worked to bridge non-representational theory and ethnography, citing the challenges of authoring

> empirical narratives that make sense—or that, in other words, are inspired by and feel coherent with the world as encountered—while simultaneously underscoring the situatedness, partiality, contingency, and creativity of that sense-making. (Vannini, 2015b: 318)

Emphasising practice, action, and performance (Vannini, 2015c: 4), non-representational theory pushes back against the totalising, fixative urges of realist representations and discourse. Such work typically entails a greater focus on *events*, *relations*, *doings*, *affective resonances*, and *backgrounds*. Less a method or technique than a *style* of writing (Vannini, 2015c: 12), it is experimental and impressionistic, aiming to 'rupture, unsettle, animate, and reverberate' (ibid: 5).

Enlisting a more-than-representational mode of writing as a way of engaging with the transformations and turbulence of his postcolonial urban setting, this *flâneur* thereby engages the performative qualities of writing, working to 'inject a note of wonder back into a social science' (Thrift, 2008: 12) and make his research 'dance a little' (Vannini, 2015b: 319). While there should be no 'escape from data' (Vannini, 2015a: 11), there is no singular non-representational method. Again, the question of how to engage one's subjects of investigation is 'never settled in advance' (McCormack, 2015: 89), with the *flâneur* working to '[make] techniques anew, albeit partially, as part of the emergence of the problem.' (ibid: 99)

In producing written texts, the *flâneur* follows Philip Vannini in making greater use of the *irrealis* mood; 'a rhetorical formula used to openly create a sense of the unreal and surreal, a sense of possibility, of condition, of wish, of fear, and of hope.' (Vannini, 2015a: 119) *Would*, *could*, *might*, *if*, *likely*, *probably*, *must*, *as if*, *apparently*, *wish*, *want*, *wow.* While the typical ethnographer would usually want to show rather than tell, 'good non-representational [researchers] may want to occasionally intimate, instead of showing everything all the time.' (ibid: 121) Capable of capturing the 'bizarre or unrealistic qualities' of colonial discourse (Huddart, 2006: 27), the *irrealis* mood can undercut the totalising impulses of literary realism, creating handles for readers (cf. Carabelli, 2014), and acknowledging the role of the researcher's subject positioning and sites of enunciation. (McLaren, 2016: 82)

5.5. Applying methods: Sociotechnical flânerie in Ahmedabad

This study builds on materials from ten months of fieldwork, conducted in two phases from 2015–16.[34] Applying the practices of sociotechnical *flânerie* in Ahmedabad, my research progressed on two fronts—through mobile observations, and membership of a local co-working space.[35] In this section, I describe the range of research activities I conducted in and around Ahmedabad; an often-eclectic combination of observational and other methods. I reflect on the types of material gathered, the scope of my records and archive, and how these materials structured my subsequent analysis and writing practice.

[34] In the gap between these two phases, I spent six months back in the UK, reflecting on material gathered during the first phase, and honing my research questions and approach.
[35] Although these two approaches overlapped, my first phase of fieldwork relied more extensively on observational research, while the second saw me building on relationships from the co-working space and following connections out into the city.

Lastly, I address some questions of ethics, including language, disclosure, my interactions with interlocutors, and issues around anonymity and masking.

5.5.a. Research activities

With few existing contacts in Ahmedabad, and no research assistance or local institutional affiliation, my initial research replicated the observational practices of the *flâneur*, as introduced earlier in this chapter. These included solo exploratory walks, visits to key sites and attractions, and attendance at organised events, including conferences and performances.

In my first weeks and months in the city, in early 2015, I undertook a series of exploratory and circuitous solo walks within Ahmedabad, as a way of acclimatising to a new environment and mitigating the effects of culture shock.[36] Building a better mental map of the city, I made deliberate efforts to traverse different districts and neighbourhoods, including parks and public gardens, the densely packed *pols* of Ahmedabad's historic core, and the city's main market and commercial areas. I explored the walled city solo and with friends, hanging out at canteens and eateries, and strolling on the riverfront. Clearly recognisable as a stranger, I was often engaged in conversation by local children, residents, and passers-by.

During these early walks, I was particularly sensitive to Ahmedabad's 'vast spillage of *things*' (Thrift, 2008: 9), a lumpy, variegated mass of bamboo scaffolding, auto-rickshaws, roadside shrines[37], *chabutra*[38], *darwajas*[39], traffic police booths, post boxes, tool sheds, electrical cabinets, tiffin boxes, padlocks, window shutters, rooftop water tanks, cellphone towers, sugarcane juice mills, air conditioning units, tyre stacks, tiled ceramic benches, and monobloc plastic chairs.[40] Alongside these objects, I noted details of road layouts and transport infrastructure; construction sites and urban development projects; advertising imagery, billboards, posters, and graffiti; malls, shopping arcades, kiosks, and

[36] Understood, here, as the 'anxiety and emotional disturbance experienced … when two sets of realities and conceptualisations meet.' (Irwin, 2007: 1)
[37] 'Sites that enshrine a worshipped object that is immediately adjacent to a public path, visible from it and accessible to any passerby.' (Larios and Voix, 2018)
[38] Intricately carved, tower-like bird feeders, numbering at least 120 in Ahmedabad's historic walled city. (Rahman, 2020)
[39] The gates of Ahmedabad's old city, having long outlived the walls of which they were once a part.
[40] General impression from field notes, 4 February 2015; individual examples from notes and photos taken January–March 2015.

street vendors; electricity pylons, substations, and telephone and power cables; and temples, shrines, and religious structures. Limned by unfamiliarity, these details troubled and radically literalised my glossing of the city as an 'enormous artifact' (Aibar and Bijker, 1997: 23). Although this initial sensitivity faded as I acclimatised to a new urban landscape, my early observations of urban things (cf. Lieto, 2017) provided a scaffold and foundation for my early notes and photos.

Alongside these more open-ended, exploratory walks, I visited key sites in and around the city, paying attention to their layout, self-representations, and enactments of context. These included monumental stepwells, both within Ahmedabad and in the neighbouring village of Adalaj; the city museum of Sanskar Kendra, a striking but neglected 1950s modernist building by Swiss French architect Le Corbusier; and Vechaar, a museum of tools and utensils attached to popular Gujarati restaurant. I visited the Mill Owners' Association Building, the former headquarters of a prominent association of local cotton mill owners; the Conflictorium, an experimental museum of arts and conflict; and Sarkhej Roza, a fifteenth-century mosque and tomb complex in southwest Ahmedabad, known as a historic centre of Sufi culture.[41] Along with a visiting colleague from the UK, I attended Rann Utsav, a state-sponsored package holiday on the Little Rann of Kutch, a seasonal salt marsh abutting the Pakistani border, in northwest Gujarat.

Supplementing these mobile observations and touristic visits, I also engaged in interface ethnography, conducting participant observation in the border areas where a given community or institution interfaces with a wider public. (Ortner, 2010: 213) I started my first phase of fieldwork by attending a four-day academic conference on grassroots innovation and creativity at the Indian Institute of Management Ahmedabad, where I co-presented a research paper with a colleague from the UK. I went to events open to the wider public, including a meetup for open data enthusiasts, an evening cultural celebration of the city's river, and a day-long conference on startups and entrepreneurship at the Ahmedabad Management Association. I queued at the international airport to see a Swiss-made experimental solar aircraft, on the day it was open for public view, and was later invited to dinner with a local family I met in the queue, including an impromptu trip to one family member's workplace, a microbiology in at one of the city's hospitals. Securing an invitation from a contact in Ahmedabad, I also attended the National Festival of Innovation, an exhibition in the grounds of Rashtrapati Bhavan, in New Delhi.

[41] The complex stands in the census town of Makarba, but is increasingly encroached upon by the Ahmedabad's westward expansion.

Separately, and running parallel to the above activities, which tracked the practices of sociotechnical *flânerie*, a second line of research unfolded through my membership of a local co-working space[42], owned and operated by a friend-of-a-friend and her husband. Occupying the upper level of a two-storey building fringed by neem and fig trees, above an artisan gift shop and café, this space offered paying members access to a shared, open-plan workspace and related services. Providing an operational base and much-needed social contact, membership of this co-working space complemented my mobile observations, visits, and interface ethnography elsewhere in the city.

This co-working space operated as a 'micro-public', enabling me to meet a range of people, breaking out of fixed patterns of interaction in an otherwise low-pressure setting. (Amin, 2002) Regular weekly 'community chai' sessions saw current and former members, visitors, friends, and guests gather to drink chai, eat snacks, and chat. Starting on Wednesday afternoons and running until the space closed, some 2–3 hours later, free-roaming conversation in a mix of English and Hindi touched on issues around traffic and road safety, the city's rental market, tax issues, entrepreneurship and business planning, politics and current affairs, cross-cultural misunderstandings, language, literature, film, and strategies for handling the ratcheting summer heat.

Skewing young and well-educated, in India as elsewhere, co-workers are usually a mix of freelance or self-employed workers, early-stage entrepreneurs, members of start-ups or small businesses, and, less frequently, employees of organisations located elsewhere. (Waters-Lynch et al., 2016: 25) At this space, they included writers and translators, designers, artists, researchers, activists, and NGO workers—largely graduates of the city's prestigious institutes of design, architecture, business, and engineering. Business cards and promotional materials around the space had been left by former members working in architectural acoustics, transport planning, post-disaster reconstruction, software development, textile buying, and typographic design.

Coming to know several of these other users, I was invited to additional sites and events. I joined heritage photo walks led by a photographer living in Khadia, a neighbourhood in the heart of the walled city. These walks offered a glimpse of daily life in the *pols*, and an opportunity to take photos with my bulky DSLR[43] camera. With friends

[42] Providing users with 'flexible, low commitment rental access to office space' (Waters-Lynch et al., 2016: 9), the practice of co-working first started in mid-2000s San Francisco, as a response to a rise in non-standard work practices and the associated 'informality, uncertainty and risks of independent work.' (Merkel, 2019)

[43] Digital single-lens reflex, producing higher-quality photos than anything taken on a smartphone.

from the co-working space, I attended a photo exhibition at Ahmedabad's Jama Masjid mosque, marking the 605th anniversary of the city's founding. Through contacts made at the weekly community chai, I also joined a local eco-tourism group for two organised, day-long jeep excursions to the Gulf of Khambhat on the Arabian Sea[44], and Polo Forest, on Gujarat's northern border with Rajasthan. This same group led a walk in the city on the night before Uttarayan, a spring festival celebrated with kite-flying and fireworks.[45] This took us out to the kite market after dark, to experience the crowds and find out more about the meaning of the celebrations, and how they had changed over the years.

On a daily basis, I alternated between walks in the city, spending time at the co-working space—writing up notes, processing photos, reading the news, and planning my next steps—and hanging out in cafes, coffee shops, tea houses, ice cream parlours, hotel restaurants, and the city's AlphaOne mall. Depending on where I was staying, I sometimes stayed talking with my hosts or fellow guests, including two Taiwanese exhibitors attending a plastics trade expo in the state capital, a Mumbai trader in town to meet his future in-laws, and a Belgian couple completing a circuit of Gujarat by Royal Enfield motorcycle. Separate from my sociotechnical *flânerie* and co-working engagements, I also met with a small number of researchers, bureaucrats, journalists, and entrepreneurs, conducting unstructured interviews in cafes or their workplaces. I made extensive use of Google Maps, monitored independent Indian and local news sites, and followed local contacts and interlocutors on social media. I regularly took one of two English-language national daily newspapers—the *Times of India* or *Hindustan Times*—tracking local and national news stories[46], editorial content, advertisements, promotions, and paid announcements.

[44] This trip including a presentation by representatives of an NGO involved in community-led mangrove restoration, mudflat-hiking, and (with the permission of local villagers) a trip on a fishing boat; for a description of the latter, see pp. 61–62.
[45] See Chapter 6; pp. 128–129.
[46] Including, among others, two subsequent years of Republic Day celebrations (January 2015, January 2016), the death of Indian cartoonist R.K. Laxman (January 2015), the Aam Aadmi Party's victory in Delhi state elections (February 2015), an H1N2 swine flu outbreak in Gujarat (February 2015), World Water Day (March 2015), water protests in Ahmedabad's Paldi neighbourhood (March 2015), the anniversary marking the NDA government's first year in office (May 2015), International Women's Day (March 2016), a strike by Gujarati jewellers (April 2016), and the 2016 Kolkata flyover collapse (April 2016).

5.5.b. Research materials

From these fieldwork activities, I generated a record comprising 35,000 words of fieldnotes, more than 600 photos, and screenshots and clippings from online media and other documents. I kept fieldnotes in notebooks and on a password-protected, cloud-based smartphone app. These included observations, details, and interview notes from my research activities, with times, dates, and immediate personal reflections. Serving primarily as a mnemonic device, these notes were mostly bullet points, usually developed from shorter, fragmented 'scratch' notes taken in the hours after an experience or encounter. Upon returning to the UK, I compiled notes and materials from different notebooks and digital files into a common document, ordering them chronologically, as a prelude to analysis.

Supplementing and complementing my written notes, this study's photographic records comprise a roughly equal number of smartphone and DSLR images. My original aim was to identify and record visual indicators of urban change, but sociologist Jon Rieger's recommendation of repeat photography, returning to the same sites and subjects over a sustained timescale (Rieger, 1996), proved impractical within the constraints of a single study. Following the principles of sociotechnical *flânerie*, I instead focused on other details and indicators. As preparation for fieldwork, I took a two-week short course in photojournalism and documentary photography at the London College of Communication, and practised photographing urban environments, artifacts, and events—paying attention to how these embodied different material traits, values, and cultural norms. (cf. Pauwels, 2010: 553)

During fieldwork, I took smartphone photos on the fly, and in settings where a bulky, conspicuous DSLR would have proved impractical. Most of these phone images are of posters, advertising, graffiti, and urban street scenes, or newspaper headlines and articles. By contrast, I used my DSLR in spaces where it was expedient to adopt the identity of a tourist or photographer, during site visits and interface ethnography. These DSLR images include material from conferences and events, including festivals and guided photo walks in the walled city. In both cases, I used photography to support practices of 'inventorying and listing', indexing similarities and thinking through the rhythms of everyday life. (Latham and McCormack, 2009: 255) Rather than treating these images merely as illustrations with little informational or expressive value (Pauwels, 2010: 566),

in the following chapters, I position them as documentary and evocation, capable of conveying a sense of place (Hunt, 2014) and illuminating encounters from my *flânerie*.

Supplementing photos and field notes, this study also draws on a range of texts, documents, and online media—including colonial-era gazetteers and glossaries, product websites, feature articles, blog posts, internet memes, maps, NGO annual reports, court and regulatory rulings, public Facebook photo albums, conference programmes, trade and in-flight magazines, leaflets, newsletters, posters, billboards, public notices, planning documents, property hoardings, Google Maps and Street View imagery, museum displays, student presentations, cinema ads and trailers, and Gujarati and Indian feature films. Diverging from established definitions of grey literature (see, for example, Mering, 2018), this diversity of sources reflects how many social settings are now 'self-documenting', with different actors producing and circulating written material and media. (Hammersley and Atkinson, 2017: 121) As sociologist Christine Hine notes, this phenomenon has only been amplified by the diffusion of internet access and social media, which have become ever harder to 'separate out … from the general flow of existence.' (Hine, 2015: 51)

5.5.c. Analytical strategies

Although I arrived in Ahmedabad with some broad research questions and foreshadowed problems concerning infrastructure and urban change[47], my analytical approach was not pre-determined, as I attempted to turn an indeterminate situation into a clearer problem space. Adopting research strategies to support this translation, I took an abductive approach to organising, analysing, and representing my research materials. (Vannini, 2015c: 11) For Iddo Tavory and Stefan Timmermans, abductive analysis offers a middle path between 'overly descriptive' research, where ethnographic vignettes or an abundance of narrative data are left to speak for themselves, and work where the researcher uses new materials to repeat or nuance an already preferred theory. (Tavory and Timmermans, 2014: 1-2) Approaching theorising as a process of creative inference, abduction, by contrast, sets out to articulate novel theoretical insights, by reframing new empirical findings in contrast to existing theories. (Timmermans and Tavory, 2012: 169, 174)

To create a situation where there was space to be puzzled by my own research

[47] See, for example, my research questions in Chapter 1; p. 5.

materials, I used research strategies to support (and generate) 'observational surprises' (Timmermans and Tavory, 2012: 169). I multiply revisited my field notes and photographs, separating this material from its contexts of discovery, specific theoretical debates, and the lived experience of fieldwork. (Bajc, 2012: 73) In practical terms, this involved transcribing my research archive onto index cards, as a prelude to spatial sorting and the application of 'techniques of frame formation and frame dissolution' (Boyer and Howe, 2015: 37). Using an eclectic range of material, preparing this card sort helped me to work out what to foreground in my analysis. Alternating between observations and theoretical generalisations, I tested alternative interpretations by comparing my materials with other possible cases, from Ahmedabad and elsewhere. (ibid: 4) This allowed me to identify 'linkages and resonances' (Boyer and Marcus, 2015: 7) as a provocation for concept development, and to raise questions about inter-situational variation.[48] (Tavory and Timmermans, 2014: 87-88; Krause, 2016: 52)

The following chapters' thematic frames emerged slowly, over the course of multiple card sorts, as I attempted to construct a sequence of inter-case comparisons that could clarify my analysis while developing or challenging current theories.[49] Certain cases and encounters quickly coalesced as fixed points, with abundant and convincing research material to anchor my analysis. At the same time, scant or incomplete data meant others had to be abandoned, or else reduced to a supporting role. The organising frame of Chapter 6 ('mutability') came easily, shaped by the books and articles had I included in my early research outlines, prior to fieldwork.[50] I originally envisaged Chapter 7 ('mobilities') as two different chapters, taking mobility and translation as independent frames, but this distinction was not supported by my research material. In fact, the frame of Chapter 8 ('worlding') was not a result of these card sorts. but budded from Chapter 7 during the writing process, mobilising unused materials to develop questions and conceptual insights seeded in the previous chapters. While writing up, I also marshalled additional research materials to support my introduction of Ahmedabad as a research setting (Chapter 4) and set up the study's discussion and conclusions (Chapters 9 and 10).

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[48] 'Here, the researcher collects actors'—and not necessarily the same actors'—actions in different settings and situations, and shows that seemingly unrelated actions make sense as a single set under the researcher's theoretical description.' (Tavory and Timmermans, 2014: 87)

[49] A strategy for 'data analysis by physically moving around concrete objects', borrowed from Vicki Macknight's comparative ethnography of five Australian schools, *Imagining Classrooms: Stories of Children, Teaching, and Ethnography*. (Macknight, 2016: 70)

[50] Specifically, Aibar and Bijker (1997), de Laet and Mol (1999), Hommels (2005), and Furlong (2011).

5.5.d. Ethical concerns: language, consent, anonymity

Reflecting on the ethical dimensions of this study, I have had to engage with dilemmas around language, disclosure, and anonymisation. Recognising how language positions the researcher in and beyond the field, my own use of English and Hindi, and level of proficiency had a significant impact on my experiences and interaction with interlocutors. (cf. Tanu and Dales, 2015) On questions of disclosure, standard biomedical models of informed consent were poorly suited to this study, requiring me to take a more flexible approach. Alongside measures taken in the field, this included analytical and representational choices, including differentiated masking strategies, rather than the blanket anonymisation of relevant people, places, and events.

Conducting research in Ahmedabad, my language use and capabilities posed a representational challenge, left mostly invisible in the written accounts anchoring the following chapters. Some of these difficulties are a result of India's multilinguistic character. The country has two national languages (Hindi, English)[51] and 22 scheduled languages, of which 13 are associated with states of the Indian Union. (Singh and Dhussa, 2020) Gujarati is the official language of Gujarat, spoken natively by 86% of the state's population. Although Gujarat was established in 1960 as a unilingual state, it remains a multilinguistic space, with its inhabitants speaking various combinations of Gujarati, Hindi, English, and other scheduled languages and local dialects. (Isaka, 2021: 160) This is even more pronounced within Ahmedabad. As historian Riho Isaka describes:

> Today, if one stands on the street in Ahmedabad, … most people can be heard speaking Gujarati (including different forms of Gujarati), but also some English, Hindi, and other languages. It is also possible to catch people using words and phrases from English or Hindi in their conversation in Gujarati, or vice versa. (Isaka, 2021: 5)

And Ahmedabad's multilingualism is only increasing. The number of people in the city with Gujarati as their first language shrank by 4% from 1991-2011 (from 72.3% to 68.3%), while the number of Hindi speakers increased from 13% to 22% over the same period. (Singh and Biradar, 2019) This census data reflects a city experiencing rapid change as its population grows, with rural-urban migration from Hindi-speaking north India shifting the city's demographics and cultural makeup.

[51] India institutionalised English, the language of colonial rule, and Hindi, the 'official language' of the anti-colonial movement, as 'all-India' auxiliary languages for those, such as Bengalis and Punjabis, who would otherwise have been unable to communicate. (Isaka, 2021: 3) Although a switch to Hindi-only was originally scheduled to take place 15 years after independence, protests in south India and the Official Language Act of 1963 forestalled this change, formalising the use of English in government schools, the courts, and other state bodies and institutions. (Singh and Dhussa, 2020: 1520-1522)

Multilingualism is not, however, unique to Ahmedabad. For many, if not all, Indians, language use varies by educational background, occupation, caste, religion, region of origin, and situational context, as different groups and individuals work to define and project their position in society. (Isaka, 2021: 9) This variation applies equally to English. While in Ahmedabad, I spent much of my time in settings where English proficiency was a marker of modernity and a sensitive 'differentiator of status within and among the middle classes' (Jayadeva, 2018: 580). With few 'shortcuts of quick fixes' to acquiring English proficiency, the language has become a marker of identity, a product of the speaker's background and schooling. (ibid.: 606-607) At the same time, English skills are correlated with mobility. At once an important 'all-India' and 'global' language, English is counterposed with India's local and regional languages, including Gujarati, whose speakers are often represented as uneducated or less mobile. (ibid: 588)

Much as an English-speaking auto-rickshaw driver might be a tragic or threatening figure, with linguistic capital out of sync with their occupation and resources (Jaydeva, 2018: 602-603), I figured that any efforts to learn Gujarati as a non-local could prove intrusive, triggering suspicion or resistance. Given my interest in urban infrastructure and national policy initiatives, I was instead attracted to Hindi's status as an 'all-India' language of elite communication and 'low-level transactional vehicle' in government and politics. (Singh and Dhussa, 2020: 1522) Furthermore, Hindi, rather than English, is the principal second language of bilinguals in Gujarat, a consequence of the state's proximity to north India's 'Hindi Belt'. (Brass, 2004: 359-360) Prior to fieldwork, I used computer-assisted language learning software to familiarise myself with the basics of Hindi's Devanagari script and orthography, pronunciation, and some limited vocabulary. Between my first and second phases of research, I built on this familiarity with six weeks of intensive tuition at a language school in Uttarakhand—which provided a different perspective on concepts, keywords, and phenomena relevant to my research. (Gibb and Danero Iglesias, 2017: 140) Though full fluency was pre-empted by a local political controversy around visas and accreditation, and my speaking skills outpaced my comprehension, even a partial working knowledge of the language proved useful when returning to Ahmedabad, softening people's reactions and facilitating rapport.

Despite this, even during my second phase of fieldwork, I spent most of my time in Ahmedabad's growing number of 'English spaces', including malls, cafes, and the co-working space. (Jayadeva, 2018; 2019) The meetings and interviews I conducted happened in English. With no interpreter or research assistance, beyond occasional ad-hoc

translations by friends and interlocutors, I undoubtedly missed many subtleties and contextual nuances, whose absence barely register in the accounts that follow. Conscious of how language was structuring my research activities, I tried to remain sensitive to how my use of English (and Hindi) foregrounded the whiteness[52], modernity, and situated nationalisms and globalities of Ahmedabad's urban infrastructure. In retrospect, these linguistic effects further centred efforts to achieve the modern infrastructural ideal (Graham and Marvin, 2001), often at the expense of system users and their experiences—an issue I revisit in Chapters 9 and 10.

Alongside language, a second set of ethical issues concerned disclosure and consent. Much published commentary on research ethics presumes an individualised model of informed consent, intended to protect vulnerable research subjects from harm. In this model, ethics and informed consent are seen as 'virtually interchangeable' (Bell, 2014: 513), an elision preventing any meaningful consideration of the trade-offs, judgement calls, and moral complexities of fieldwork. (Thorne, 1980: 294) Informed consent is particularly poorly suited to interpretivist and ethnographic research; approaches with fewer and less clear-cut risks and benefits, and which offer researchers far less control over their environment. (ibid: 285) It is, however, possible to talk about research ethics without recourse to these individualistic, biomedical models. (Bell, 2014: 518) Rather than approaching disclosure and consent as a one-off act, easily recognised, it may be preferable to consider the 'array of research "bargains" … struck in the course of field research.' (Thorne, 1980: 285)

In my case, I arrived in Ahmedabad with an interest in all things 'sociotechnical' (Hughes, 1983; 1986), and the expectation of 'studying sideways' (Ortner, 2010: 222). Lacking a local institutional affiliation and the correct research visa, I avoided interviewing government or municipal officials, for fear of illegibility or state reprisal. Looking elsewhere, I was able to build rapport based on shared interests, demographics, and normative commitments, gravitating towards people operating in a 'world of knowledge, information, representation, interpretation, and criticism' not so different from my own. (Ortner, 2010: 223) Some were attracted to my status an outsider, or saw my research interest as conferring legitimacy to their own activities. In a couple of cases, I had to work hard to avoid being co-opted by groups who would have demanded sustained commitment, monopolising my time and energies. Other people I spoke to, however, were simply interested in a 'study of their own world.' (ibid.)

[52] See following interlude, 'Assembling whiteness.'

On questions of disclosure, I was open about my research interests and identity as a graduate student. To do otherwise would have been dishonest, and a breach of trust. But in applying techniques of *flânerie* and interface ethnography while emphasising the sociotechnical, much of my research occurred away from sustained interactions with individual interlocutors. As sociology Barrie Thorne notes, it is easier to defend disguised research when it takes place in the kinds of 'fleeting encounters and public settings' that characterise sociotechnical *flânerie*—spaces where the risks (and benefits) of my study were further reduced, and people were already on guard. (Thorne, 1980: 289) Indeed, many people I interacted with remained strangers, with shared external circumstance leapfrogging the need or opportunity for introductions. At the same time, the instability and multiple worldings of urban infrastructure in Ahmedabad meant people's understanding of my research goals was frequently quite different from my own. For many, the assumption seemed to be that I was focusing on Ahmedabad's built environment and construction projects, and not the experiences, opinions, or beliefs of the city's inhabitants—something I tried to correct, with varying levels of success.

In hindsight, many of my engagements with people in Ahmedabad were effectively 'go-alongs' (cf. Kusenbach, 2003), joining encounters that would have gone ahead without me.[53] Featuring multiple actors, and often taking place in public or institutional spaces elsewhere in the city, my access was granted by individual sponsors, whose preferences often overrode other participants' ability to meaningfully consent.[54] (Thorne, 1980: 292) At the time, these experiences appeared to share more with my solo visits and interface ethnography than the formal, structured meetings I had imagined. Even the few one-on-one interviews I conducted seemed to minimise my role. With scant opportunity to develop rapport, those I met engaged me as representatives of their projects or organisations, responding to my questions with practiced self-representations and accounts diverging little from official discourse.

The only setting that stood apart from these experiences was the co-working space. A 'micro-public' in action (Amin, 2002), the venue's weekly 'community chai' events operated as a form of *adda*, a social institution and conversational practice with multiple participants, who gathered for free-flowing, unstructured conversation in an informal setting.[55] (Chakrabarty, 1999; Bhattacharya, 2017) For me, this regular social institution

[53] Comprising, for example, group walks, site visits, car journeys, and orientation sessions.
[54] In these cases, I have masked the identities of those participants who were not my immediate sponsors.
[55] I am grateful to my internal thesis examiner, Saurabh Arora, for making this connection.

offered a social short-cut, quickly bootstrapping rapport with other regular attendees. Taking place in a co-working space, it offered participants access to new clients and potential collaborators, while helping stabilise their social identity as independent workers. (Merkel, 2019) Resisting the 'gravitational pull of any explicit purpose' (Chakrabarty, 1999: 135), the *adda* wandered from subject to subject, following its members' diverse interests. (Bharracharya, 2017: 11) Discussion tended to be good-natured, requiring 'expressiveness, unseriousness, and [a] suspension of consequentiality' on the part of participants, with any conclusions or points of closure indefinitely deferred. (Thorne, 1980: 289)

There is a difference between studying private spaces and foreign cultures, where the researcher is a recipient of hospitality, and more powerful or public institutions., which may deserve greater scrutiny. (Nader, 1972: 304-305) But for those studying sideways, rather than 'up' or 'down', the choices and bargains are less immediately clear-cut. During the analysis of my research materials, I decided not to write about the co-working space, using the relevant notes and images only as background, or to triangulate my interpretations. Unable to take recordings or make notes without breaking the *adda*[56], I would have faced difficulties faithfully rendering the ebb and flow of discussion in writing. Furthermore, while the venue was open to visitors and paying members, it nonetheless felt like a private space. As new co-working members joined and others left, and *adda* participants shifted on a weekly basis, it was impossible to break the flow of interaction by disclosing to each new participant that they had unwittingly entered a research zone. (Thorne, 1980: 292; Bosk, 2001: 211-212) Even among the regulars who were aware of my research, sustained interaction made it easy for them to forget my role, thinking of me exclusively as a friend, acquaintance, or co-worker. (Thorne, 1980: 291)

Dominated by methodologically individualistic models of informed consent, institutional research ethics frameworks also have little to say about the ethics and politics of representation. Such models tend to simplify the act of writing, treating it as a transparent, self-evident translation of the researcher's empirical materials for a scholarly audience. (Bell, 2014: 516) But in reality, 'many [researchers] would … recognise their role in enacting their object of study' (Lancaster, 2016: 98), with writing as a deeply political act. From the standpoint of ethnographic research, theoretically valuable or 'rich' research material is that which subverts or contradicts official accounts, existing public understandings, and received wisdom. (Bosk, 2001: 206) Balancing a desire to test,

[56] But equally unable to rely on these activities to make my research role visible.

challenge, or reveal the incongruities of dominant discourses with a responsibility to protect participants from harm, these disciplines have adopted conventions of masking and omission. (cf. Weiss, 2021) Within this, however, remain choices about what needs to be masked, and how. (Jerolmack and Murphy, 2019)

At a technical level, masking practices prevent harm by distancing the events and participants depicted in written accounts from a 'public sphere shared with researchers and readers' (Nespor, 2000: 567). Inverting normal scholarly citation practices (Weiss, 2021), this denial of coevalness breaches the spirit of *flânerie*, which aims to produce texts of use to academic audiences, interlocutors, and relevant communities of practice. At the same time, anonymisation bolsters the authority of the researcher, further distancing them from their readers. As sociologists Colin Jerolmack and Alexandra Murphy observe:

> While the ethnographer may disclose all the details that *she* deems necessary in light of her particular theoretical interests, for readers, masking may withhold information that *they* consider crucial for independently evaluating the ethnographer's analysis and considering alternative explanations. (Jerolmack and Murphy, 2019: 803)

This twin distancings have scholarly implications. With it being impossible for researchers to anticipate how their work might contribute to readers or interlocutors' interests, greater disclosure could, for example, enable replication through 're-visits', more fine-grained comparison, and the triangulation of data. (Jerolmack and Murphy, 2019: 804, 815)

In the following chapters, I have had to balance the competing requirements to avoid causing harm, respect my interlocutors' interests, and act with integrity, while providing faithful accounts of real people, places, issues, and phenomena. (Vorhölter, 2021: 15; cf. Zeitlyn, 2009) Recognising power as fluid, relational, and open to challenge, a one-size-fits all approach to interviewing and anonymity—even among similarly positioned actors—is not just unnecessary, but may risk causing harm. (Lancaster, 2016: 97) In my own written descriptions, I adopt a partial and variegated strategy, naming places and infrastructure projects, and some people and organisations, while assigning pseudonyms to others[57], and depersonalising sensitive insights and comments, finding ways to weave them into the text as background or context, or omitting them entirely.

Centring the city of Ahmedabad as a subject as a much as a research setting has made it harder to guarantee anonymity. Many of the people, projects, and organisations I

[57] Something requiring additional sensitivity in a setting such as India, where names carry charged connotations around religion, caste, and regional identity.

encountered are highly distinctive, or unique within the city. Effective anonymisation strategies would require a high level of abstraction, pressing me to alter or omit many key identifying details. (Nespor, 2000: 559) Given the focus of my research, it makes little sense for me to separate people, encounters, and events from their real-world contexts. Even were I to succeed in doing so, this would prevent me from contributing to academic and public conversations about real places and issues. (Vorhölter, 2021: 19) In sacrificing anonymity, says Nancy Scheper-Hughes, 'we might have to write a less poignant, more circumspect ethnographies' (Scheper-Hughes, 2000: 128). Although the risks of this project were less pronounced than many, Scheper-Hughes' enjoinder has nonetheless been helpful in moderating my analysis and written accounts—leading me to omit some details I might otherwise have included.

5.6. Discussion

In this chapter, I introduced the method of *flânerie*, as embodied in the figure of the *flâneur*, a solitary loiterer and stroller, whose pedestrian mobility and peculiar modes of observation saw him 'botanizing on the asphalt' (Benjamin, 2006: 68) Tracing the mobilisation and application of this figure, and the component practices of his research, I worked to further extend *flânerie*, from its position in contemporary urban studies and at the ethnographic 'periphery' (Coates, 2017: 30), qualifying and adapting its component practices—*pedestrian mobility*, *observation*, *knowledge production*, and the *authorship of texts*—to better accommodate, first, the investigation of sociotechnical phenomena, and, second, studies of the postcolonial city (see Table 2).

In the following chapters, I attempt to modulate and, where possible, reconcile the differing tendencies of these two variations, as I extend *flânerie*-derived methods to the investigation of sociotechnical phenomena in a postcolonial urban setting. Shuttling between the two, key differences include the relative ease of pedestrianism; whether observations are solitary or made as part of a more engaged group practice; between the deliberately unhurried pedestrian gait, and a mix of differing velocities; the sensory and the reflective; whether the researcher is part of the urban crowd, or estranged from it; the production of 'realistic' texts addressing an academic audience, and those demonstrating more literary, performative characteristics.

Operating at the interface of the sociotechnical and the postcolonial, this reworked

flânerie proves well-suited to the slippery, elusive, longitudinal-durational, more-than-local character of infrastructure and urban change. Its component practices support the more processual, relational approach suggested by work on urban and ontological experiments, and the incremental achievements of heterogeneous infrastructure configurations. Derived from the application of *flânerie* and affiliated methods in this location, Ahmedabad, at this moment in time, following the 2014 BJP election victory, in a field site shaped by a situated laying of Hindutva, neoliberal, Nehruvian, colonial, and pre-colonial forces and dynamics, the following chapters mobilise mutability, mobility, and worlding as sensitising concepts; a heuristic choreographing the faithful accounts (Zeitlyn, 2009) of my encounters in and around the city.

Interlude: Assembling whiteness

In engaging with how my whiteness *mediated* my body contact with Ahmedabad (cf. McLaren, 2016), I am eager to move beyond an 'unproductive and paralyzing focus on guilt' (Faria and Mollett, 2016: 82), and attend instead to the material and emotional workings of race and whiteness—the work they do, and what they *produce*. With much of whiteness studies (cf. Roediger, 1991; Dyer, 1997) firmly rooted in the racial politics and ontologies of the 1990s-2000s United States (cf. Giroux, 1997), and, as such, ill-suited to unravelling the peculiar workings and productivity of my own whiteness while in Ahmedabad. Instead, I turn to work that treats race as an assemblage or product of assemblages (Saldanha, 2007; Weheliye, 2014), and writings show how whiteness, in particular, relates to the existing racial politics and ontologies of contemporary India. (Dhillon, 2015)

Assemblages. In making use of practices of reflexivity and disclosure, I have tended to start from a *relational* understanding of race, gender, and other identity markers; treating them not as 'ineluctable "things", destinies, or "beings"', but 'malleable social productions.' (Gillen, 2015: 586) Like these other markers, whiteness is fluid, mobile, and unstable. Assemblage approaches take this a step further, focusing on the 'processes of composition that produce durable orderings', and the 'ontic indeterminacy' of what might typically be treated as 'totalizing practices' (Anderson et al., 2012: 175). This, I argue, can be productively extended to questions of race and whiteness.

My approach builds on Arun Saldanha's 2007 ethnographic monograph, *Psychedelic White*, which applies assemblage theories to an investigation of the white trance counterculture of Goa, a former Portuguese colony on India's west coast. For Saldanha, racial difference is an *event*, a 'process of differentiation' (Saldanha, 2007: 9) emerging as 'bodies in the real world align and comport themselves in certain ways, in certain places.' (ibid: ix) This analytical approach stresses the *viscosity* of whiteness; describing how collectives of bodies stick together, and demonstrate a 'relative impermeability.' (ibid: 5) Foregrounding the physicality of bodies and their grammars of interaction, he describes how whiteness is about bodies as a *collectivity*, rather than something that inheres to the individual, with bodies' relative *viscosity*, or stickiness, explaining the cohesion of whiteness. (ibid: 50)

Alexander Weheliye also takes an assemblage approach to race and racialisation, but where Saldanha looks at race as an assemblage, Weheliye focuses on 'racializing assemblages of subjection' (Weheliye, 2014: 2). He uses this term to denote the webbed processes of making-raced, perpetuated through 'institutions, discourses, practices, desires, infrastructures, languages, technologies, sciences, economies, dreams, and cultural artifacts' (ibid: 3). Such racialising assemblages produce racial categories, which are then 'coded as natural substances' inhering to bodies (ibid: 50); devices disciplining 'humanity into full humans, not-quite-humans, and nonhumans.' (ibid: 4) For Weheliye, race is neither biological nor cultural, but the product or output of racialising assemblages; a 'conglomerate of [disciplining] socio-political relations' with no real biochemical foundations. (ibid: 3) Similarly, whiteness is not a quality or designation of any actually-existing groups, but instead, the *architect* of such assemblages, constituted as a 'series of hierarchical power structures that apportion and delimit … [who] can lay claim to full human status.' (ibid: 19)

Read together, Saldanha and Weheliye show how assemblage approaches can reorient understandings of race and whiteness away from the individual, raced body, to the *viscosity* of raced collectives and aggregates (Saldanha, 2007), and the systems and structures that *produce* racial categories. (Weheliye, 2014) Together, these works sensitise us to 'iterative performances of social differentiation in moments of encounter'; enabling researchers to appreciate race 'as simultaneously fluid and fixing'—'stabilized', at least for a time, as a 'provisional formation' comprising a wide range of 'human and non-human parts' (Anderson et al., 2012: 173).

India's 'pigmentocracy'. Seeking to extend these assemblage-based approaches to race and whiteness to an Indian context, I focus on the challenges of situating my own—ex-colonial, British—whiteness in relation to an Indian substrate of racialized power that Komal Kaur Dhillon dubs 'pigmentocracy'. 'Pigmentocracy' describes a process of racial ordering running parallel to India's caste system and internal geographies of difference, fostering subjects' desires 'to gain closer proximity to whiteness' (Dhillon, 2015: 41). Constituting an 'ideological distancing' of lighter and darker upper and lower castes through practices and processes of internal differentiation embedded in casteism and classism, pigmentocracy is inward-focused, occurring intraracially. (ibid: 79) Nonetheless, the above work on racial and racialising assemblages (Saldanha, 2007; Wehiyle, 2014) can also, I suggest, be extended to Indian social relations.

Born of high-caste Brahmins attempts to 'approach whiteness (ideologically, physically, etc.) through emulation of Western models' (Dhillon, 2015: 12), pigmentocracy is far from innocent of the colonial experience. Today's metropolitan Indian elites reproduce a 'hegemonic paradigm modelled by colonizers and informed by whiteness' (Dhillon, 2015: 58). And though Ahmedabad was insulated, to a great extent, from the full force of colonial influence (Tambs-Lyche and Sud, 2016: 275), Dhillon's 'pigmentocracy' applies as much here as elsewhere in India. With a contingent alignment of whiteness and wealth, exemplified by both whites and their 'native' elite caste and non-Hindu allies, producing hierarchical structures 'entrenched in white racialized aesthetics and affluence' (Dhillon, 2015: 58), colonial and postcolonial 'attempts to perform whiteness by nonwhites' provide critical sites to usefully elucidate the contours of whiteness. (ibid: 41)

Putting it into practice. Focusing on whiteness as something active, productive, 'much more than simply the negation of nonwhiteness' (Saldanha, 2007: 8), I attend to the ways in which whiteness is *felt*, rendered perceptible, 'produced, dismantled, and remade' (Faria and Mollett, 2016: 80). To this, I add an emphasis on the material and compositional dimensions of whiteness, following Saldanha in reflecting on how my own whiteness was produced not just through my body, but by my relations to and with my DSLR camera, rucksack, brown leather hiking boots, sandals, sunglasses, clothing, passport, train and airline bookings, accommodation choices, smartphone, debit and credit cards, anti-malarial tablets, travel vaccinations, pens, notebooks and notetaking apps, handwriting, laptop computer, email and social media accounts, university registration, Google Translate language packs, habits of cinema attendance, resistance to disclosure my religion or marital status, and inability to comfortably ride pinion on a motorcycle.

In including this focus on race and whiteness as an interlude following my research methodology, I treat the mediating role of my whiteness as much as a source of data as of bias (McLaren, 2016), capable of revealing the mechanisms and effects of infrastructural systems, and processes of urban change. While my whiteness marking me as a stranger, a tourist or *firangi*[58], and my misplaced body limiting my movements in particular ways, a demonstrable interest in design, innovation, and the city's urban systems facilitated access and passage through certain spaces, even as I continued my *flâneur*'s disengaged wanderings.

[58] 'Foreigner.'

Chapter 6: Mutable infrastructures

6.1. Introduction

In this chapter, I address the mutability of infrastructure, bringing notions of obduracy, fluidity, and material resistance to bear on a series of encounters with halogen street lighting, water storage systems, bus rapid transit, and a for-profit bicycle-sharing service. Mobilising these examples in mapping the diverse, cross-cutting relations of mutability and obduracy, I lay the groundwork for an argument that unfolds over the following chapters. These three chapters critique constructivist accounts of the stabilisation, diffusion, and global homogenisation of technology and infrastructural systems. Instead, I share cases and encounters that highlight relations of *mutability*, *mobilities*, and *worlding*—providing greater purchase on the interactions between infrastructure and urban change.

In the first section, I recount my disconcertment in encountering new halogen street lights in the *pols* of Ahmedabad's historic walled city, an encounter showing how the modern infrastructural ideal is implicated in orientalist and colonial hierarchies of value. In the second section, I extend this analysis to water supply and storage infrastructures. Sharing field observations of a fifteenth-century stepwell, rooftop water storage tanks, and the renovation and repurposing of an underground cistern, I show how mutability can either enable or constrain a given system's survival, modification, or re-use. Turning to transport and mobility, in the third section, I focus on the interface of two systems: the city's 'Janmarg' Bus Rapid Transit, constructed by the city in the 2000s, and MYBYK, a for-profit bicycle-sharing service. Investigating three divergent framings of the interface of these two systems, I show how obduracy and mutability can be considered in relational terms, rather than as a categorical property of a given system or artifact. In the final section, I bring these cases together, reflecting on the implications of my observations and analysis for the chapters that follow.

6.2. Street lighting in the pols

April in Ahmedabad. After ten days in the Himalayan foothills, seeking respite from a thickening heat, I have returned to the *haveli*, a restored 'heritage' property in a Jain *pol*.

Falling into a daily routine, the streets and alleyways quickly assume a certain familiarity; here the barbers, the legal clerk, the shrine with the wrought iron peacock gate; there the stern-faced woman staffing a telephone kiosk, a tarnished red receiver as her signboard. Following the road out to the *pol*'s main entrance, my path crosses an intersection where the densely-packed buildings fall away—a *chowk*, a pocket of open space in among the labyrinth of streets and passages.

On this Friday morning, moulded plastic chairs and tables have been fetched out from people's homes; bamboo scaffolds sketch a skeleton of incomplete structures, as serious-faced men struggle with amplifiers and speaker cables in the shade of a canvas awning. Returning later, at dusk, these structures and equipment are joined by a series of halogen street lights, illuminating the *pol*. Struck by their apparent sturdiness, fully cemented into the street and with no generator or visible power source, I linger to take a couple of photos with my camera.[59] Quick to assert their ephemeral nature, my qualification of the lights as 'serious, albeit temporary' in my field notes registers a note of puzzlement, prompting further questions: 'All for a single-day festival. Where did they come from? How are they powered? Who installed them? When are they stored when not in use?'[60]

Two months earlier, in February, during an earlier stay in this same heritage property, my usual evening walk to a local Havmor ice cream franchise had been interrupted by a *baraat* wedding procession.[61] As a student of technology studies, my attention was immediately drawn to the wedding band's *teliya*[62]; hauling a sound system and speakers, with a built-in keyboard, power source, and microphone for the MC. The cart also provided power for a loop of ornamental lamps marking out a mobile dance floor, bulbs held aloft by members of the costumed wedding band, drawing a crowd and laying claim to space—all followed up by a groom on horseback.[63]

It had been a weekend of weddings, would-be couples capitalising on a window of favourable astrological auspiciousness. Tents and marquees sprouted like mushrooms, elaborate entrances to party plots stretching out into the street. Leaving the house the

[59] From field notes, 10 April 2015.
[60] Field notes, 10 April 2015.
[61] A 'ritualized journey' establishing a new relationship between the families of a bride and groom, the *baraat* uses sound, light, and the bodies of two columns of bandsmen to create a 'moving physical and ritual frame' (Booth, 2008: 69), tens of metres long.
[62] A cart or wagon.
[63] From field notes, 8 February 2015.

following morning, I barely registered the group of men setting up for an event, but, returning home at the end of the day, I found my route blocked by a throng of guests making the most of an impressive audio rig and improvised dance floor. Picking around the revellers, I kept my head down, hoping to avoid being drawn in. Back at the *haveli*, I jettisoned my earplugs to listen to the music, which stretched on past midnight—base layer to a soundscape that included the muffled conversation of two Taiwanese guests in Gujarat for a plastics convention, the whining of street dogs, and the clicks of an off-centre ceiling fan.

As I stop to take photos and document these sudden street lights, I am thinking of these prior encounters. In a world of neighbourhood-scale, pop-up sound systems and wheeled, self-powered DJ booths, surely, these *pol* lights were another example of the use of sound and light to enforce a symbolic separation of festive or ritual space, demarcating it from the quotidian world of everyday life. But as the weekend draws to a close, as the canopies are taken down and the chairs and tables moved back inside, the halogen lights remain. Venturing beyond the *pol*, I am disconcerted to see more of the same, elsewhere in the walled city. Evidently, they are not so temporary after all.

This embodied, ephemeral experience of *disconcertment* (Verran, 2001) troubled my existing conceptual frames, confronting me with the limits of their explanatory power. (Strathern, 1999: 6) Though it is tempting to bracket such disconcertment as a failure of knowledge production, easily remedied or repaired (Fabian, 1995: 41), I start this chapter by following those who recommend lingering over such moments of discomfort and unease, treating them as a symptom of 'metaphysical disjuncture' (Law and Lin, 2010: 137), or a 'first clue in [the] struggle to do useful critique' (Verran, 2001: 5).

Registering and *enacting* the difference between the transient, improvised ritual apparatuses of Ahmedabad's historic walled city and the durable civic systems of the modern ideal (Graham and Marvin, 2001), this disconcertment reveals something of my embodied subjectivity. In the moment, my casing of these *pol* street lights as temporary, likely festive, rested on a comparison establishing relations of similarity between my encounters with the street lights, the *baraat*, and a previous celebration in the same *pol*. Unarticulated in the above description, however, is a tacit comparison between India and the UK; my own constitution of context (Fabian, 1995: 48) mobilising proto-theories, preconceptions, and tropes casting the Indian city as irreducibly otherwise.

Though my casing of these lights as part of a festive or ritual apparatus relied, to a large part, on the timing of their installation, which coincided with preparations for a local celebration, this also required my discounting of the most likely alternative hypothesis—in this case, the municipality's willingness to extend new infrastructure to a neighbourhood that had otherwise been neglected. My assertion of the former over the latter rested on two sets of assumptions, 'deeply ingrained' in my perceptions of the city. (Timmermans and Tavory, 2012: 172-173) The first of these cast Ahmedabad as a messy, complex milieu, while the second stressed the ingenuity of a resource-deprived subaltern 'grassroots'. Together, these assumptions figured the lights as an improvised solution by agents unseen, appropriating the streets of the *pol* for some festive or religious event.

At the time of this encounter, my own early-stage culture shock mirrored characterisations of the Indian city as 'opaque and bewildering', exceeding the would-be analyst's frames of reference. (Gandhi and Hoek, 2012: 3; cf. Irwin, 2007) My experiences echoed research on cities elsewhere in South Asia; work describing how a 'perpetual sense of instability' and 'overproduction of ambition and desire' can impinge on the sense-making efforts of researcher and resident alike. (Gandhi and Hoek, 2012: 3-4; cf. Trovalla and Trovalla, 2015a; 2015b) Tracking cues and details of infrastructure, urban technology, and sociotechnical change, Ahmedabad's spatial potentiality (Gandhi and Hoek, 2015: 7) and 'urban charisma' (Blom Hansen and Verkaaik, 2009) seemed to challenge the prescriptive rigidities and bounded systems of the modern ideal.

Accompanying preparations for a festival or community celebration, these lights appeared alongside plastic chairs, tables, a scaffolded canopy, and audio-visual equipment—one in an array of elements blocking the road. With an often-blurred division of public and private space, the uses of Ahmedabad's streets shift with season and time of day, with roads as 'dynamic features' of the urban landscape, serving multiple functions. (Wilson, 2013: 75) This flexibility of use survived a dramatic reconfiguration of the city's urban space by an indigenous elite in the 1910s–40s, late in colonial rule. (Pramar, 1987; Raychaudhuri, 2001) Seeking to divide land into public and private space, municipal officials 'opened' areas deemed congested, realigning and constructing new streets. (Raychaudhuri, 2001: 686, 705-707) Many of the *pols*' inward-facing cul-de-sacs became public thoroughfares, breaking through the enclosing ends to allow vehicular traffic. (Pramar, 1987: 341) Reconfigured, these streets no longer formed an organic system of enclosures, but, instead, connected newly dislocated sites of commerce, residence, and so on. (Raychaudhuri, 2001: 706)

For those aware of these prior transformations, the celebration outside the *haveli* reflected residents' perceptions of the *pol*'s streets and *chowks* as their patrimony, readily appropriated for a marriage, *garba* dance, or *katha*.[64] Writing in the 1980s, V.S. Pramar described how 'one may find such a street closed to traffic because some influential family is celebrating a wedding' (Pramar, 1987: 341). These persistent traditions have been othered as rural behaviour betraying a 'lack of civic sense', out of phase with Ahmedabad's contemporary built environment. (Pramar, 1987: 341; cf. Hommels, 2008) At the same time, such uses track an earlier configuration of the *pols* as private property held in common, managed by community institutions and customary norms. (Gillion, 1968: 25)

Reflecting on the city's unstable materialities, it is instructive to compare the *pol* residents' appropriations of street space with *Happy Streets Ahmedabad*. Operating on Sunday mornings from December 2014–May 2017, the *Happy Streets Ahmedabad* campaign closed one side of C.G. Road, a busy commercial artery in the west of the city, to motorised traffic. Spearheaded by the *Times of India* newspaper, co-branded with their Gujarati-language broadsheet *NavGujarat Samay*, and supported by the AMC, traffic police, an environmental non-profit, and private sponsors, the campaign enabled people to use the space to walk, cycle, roller skate, and practice yoga.[65] (Mehta, 2016) Taken together, the *pol* celebrations and *Happy Streets* campaign both appropriated street space to further civic culture and social cohesion. But where the *pol* celebrations were othered as a residual practice, marking the 'backwardness' of the walled city, *Happy Streets* provided a platform for Ahmedabad's young, urban middle classes to enjoy 'globally prevalent practices of urban leisure' (Mehta, 2016: 203).

Overcoming a mismatch of social practice and the scripting of urban space, revellers' appropriation of the streets outside the *haveli* was, it seemed, enabled by their interventions in a *reconfigurable* material world. In a north Indian idiom, such highly situated, often quotidian interventions are understood as acts of *jugaad*—a term originally denoting jury-rigged vehicles, but which has since become popular slang for a 'quick fix' or 'making do' (Birtchnell, 2011: 358). Whether a noun or verb, *jugaad* is a locally crafted, intermediate solution (Sekhsaria, 2013: 139), at once elegant and makeshift (Rai, 2019: 2), allowing everyday life to function 'even in the absence of permanent, durable

[64] A form of religious storytelling, and Hindu ritual event.

[65] Visiting in December 2014, political scientist Mona G. Mehta describes a scene where uniformed students—'bussed to the venue'—showcased their karate and taekwondo skills, while entertainers atop a makeshift, heavily-branded podium 'used music and microphones to entertain the audience of mostly young men and women through dance and aerobics.' (Mehta, 2016: 202)

infrastructures.' (Kaur, 2016: 314) Researchers tracking *jugaad* cite washing machines repurposed to mix *lassi*[66] (Sekhsaria, 2013: 139) and wash vegetables (Rai, 2019: 48), or a 1979 photograph of an Indian space agency rocket 'balancing precariously on a bullock cart.' (Birtchnell, 2013: 78) Motivated by pressing problems under conditions of resource scarcity, these *jugaad* reconfigurations put existing materials to previously unimagined uses[67]; acts of translation 'creating new worth and value.' (Sekhsaria, 2016: 83)

Following this, I thought the *pol*'s street lights, despite their sturdy appearance, could have been an act of technological *jugaad*, with residents sourcing illumination for their celebration by tapping an existing electricity connection. Or had I fallen for the hype, too quick to buy into popular narratives of the intrinsic ingenuity of India's *aam aadmi*, or common man? Certainly, stories and images of heterodox washing machines and bullock-pulled rockets have contributed to a recognisably 'Indian' innovation narrative, in which adversity and low state capacity are a wellspring of ingenuity, enabling individual Indians to author their own destinies. (Kaur, 2016: 315, 323) Enabling its practitioners to circumvent blockages or obstacles, *jugaad* is celebrated as a feature of post-reform India, supported (as 'frugal innovation') by government policy, and, increasingly, packaged as a business and management philosophy; a matrix of homilies and prescriptions for resource-constrained innovation, spread by India's transnational diasporic elite. (Birtchnell, 2011; 2013)

Co-opted by capital and the state, this 'heroic' iteration of *jugaad* betrays the concept's grounding as a subaltern 'practice of the precarious' (Rai, 2019: 159). As practiced at ground level, *jugaad* springs from strategies for negotiating poverty, discrimination, and violence; such are always provisional, situated singularities, 'experiments in getting over the next hurdle' (ibid: 47). The proverbial common man is not a proxy for the nation, but a marginal figure; denoting he[68] who suffers the 'lacks and absences of public infrastructure' (Kaur, 2016: 315). Where heroic images of *jugaad* locate agency in his virtuosic ingenuity, extrapolated as an 'extraordinary feature' essential to the Indian nation (Kaur, 2016: 315; Rai, 2019: 30), the lived reality of *jugaad* rests less on the

[66] A blend of yogurt, water, and spices, available in sweet and savoury versions.
[67] These accounts of *jugaad* parallel Lucy Suchman's feminist, anti-heroic efforts to 'decenter sites of innovation from singular persons, places and things to multiple acts of everyday activity' (Suchman, 2009: 1); work stressing the 'the always relational character of capacities for action; the constructed nature of subjects and objects, resemblances and differences; and the corporeal grounds of knowing and action.' (Suchman, 2005: 2)
[68] Like Benjamin's *flâneur*, the *jugaadu* is typically gendered as male. (cf. Rai, 2019; Irani, 2019)

individual actions of self-maximising agents than 'a collective if distributed practice of everyday life' (Rai, 2019: 10).

To take one example, anthropologist Parvis Ghassem-Fachandi describes the prevalence of improvised Hindu shrines and 'bathroom-tile temples' in Ahmedabad. (Ghassem-Fachandi, 2012: 17) Typically small and informal, these 'wayside shrines' (cf. Larios and Voix, 2018) mushroom on traffic islands and at busy intersections, spilling over into roads and thoroughfares. (Ghassem-Fachandi, 2012: 14) Adjacent to the street, and thereby able to capitalise on the daily routines of the city's mobile subjects, the minor structures sustain livelihoods, hosting *sadhus*[69], shops, and street vendors. (ibid: 16-17) Neither institutional nor domestic, unregistered, and usually encroaching on public land, questions about the circumstances of such structures' origins are met with silence, as followers disavow the role of human agency in their construction. A frequent claim is that the relevant saint or deity 'chose' the site, asserting their presence through 'bubbles and lumps in the asphalt' or the form of 'an idol or image growing out of the ground' (Ghassem-Fachandi, 2012: 17). Demonstrating a dynamic, 'mushrooming' materiality, a given wayside shrine might grow, shrink, or vanish entirely, 'appropriating the surrounding area ... with makeshift structures' during festivals or deity-specific celebrations. (Larois and Voix, 2018: §15)

Supported by neighbours and supplicants, the most successful shrines acquire the trappings of permanence, with ceilings, protective grills, and—in some cases—telephone or electricity connections. (Ghassem-Fachandi, 2012: 17-18) Parvis Ghassem-Fachandi's account of how the neighbours of a prominent wayside shrine allowed an electricity connection to be made to the structure from their house (Ghassem-Fachandi, 2012: 18) reflects a paradigmatic figure of *jugaad*, in which the would-be *jugaadu* secures access to electricity by bootlegging a neighbour's connection, or hacking into the municipal power grid. (Birtchnell, 2013: 23; Rai, 2019: 108) Considering the extra-legal status of these shrines[70], the elision of human—let alone *heroic*—agency reflects a less clear-cut mode of sociotechnical intervention. Blurring the role of human agency in appropriating public space, this example is faithful to *jugaad*'s distributed, ecological practices of material reconfiguration. (Rai, 2019)

[69] A holy man, sage, or ascetic.
[70] Their continued existence relying on the non-enforcement of federal law prohibiting unauthorised religious structures. (Larois and Voix, 2018: §29)

Returning to my original encounter, having missed the moment of installation, it was plausible to imagine the *pol*'s residents mobilising the resources to procure halogen event lighting, however 'serious' and extensive. Recalling the *baraat* wedding procession, such bands advertised their presence in Ahmedabad with flyers, signage, and carts parked on the roadside. Perhaps, I reasoned, there was an analogous private organisation supplying static lighting and generators for community celebrations, weddings, and religious events. Alternatively, an individual or small group could, conceivably, have solved the problem of event lighting through material reconfiguration or technological *jugaad* (Sekhsaria, 2016: 96-98), reworking—extra-legally, and with a liminal precarity—the existing relations between private electricity users and the municipal power grid. Figured as a subaltern intervention troubling standard demarcations of public and domestic space, such an addition could, I reasoned, be ascribed to those same men seen readying the neighbourhood for the festivities to come.

In the event, the sudden appearance of these halogen lights was not, as first assumed, part of an effort to assert an appropriation of space; nor did it constitute the subaltern intervention of a marginal, resource-constrained 'grassroots'. Disabused of such theories, my visceral disconcertment was a detector of difference (Law and Lin, 2010: 137-138), interrupting an initial figuring of these halogen lights as temporary, reconfigurable, deployed in service of a festive event. The lights were, as I noted, 'serious', but they were not a short-term solution. Instead, their apparent durability asserted their status as a permanent, formal addition to the walled city's infrastructure and built environment. Although this seems like an instance of the modern infrastructural ideal working as intended, my misconceptions and subsequent disconcertment registered a wider range of materialities than that those acknowledged by visions of infrastructure as fixed, invisible in its obduracy. My quickness in casting these lights as 'other' to the modern ideal shows how these diverse materialities are reified through binary oppositions—familiar pairings of formal and informal, legal and 'extra-legal', permanent and temporary, modern and backwards. Fixing and naturalising difference, these binary categories produce a clear hierarchy of value, elevating those materialities deemed to be formal, permanent, modern, and well-ordered over those which are not.

Having adopted a set of *flânerie*-inspired research methods, the process of fitting unexpected or anomalous findings into an interpretive framework (Tavory and Timmermans, 2014: 123) might typically see recourse to context as a corrective. (Fabian, 1995) In this encounter, however, my efforts to contextualise and situate the phenomena

were the source of my misconceptions. Ahmedabad's *pols* have long been cast as backward; presented either as a Muslim-coded source of disorder and violence, or, more recently, as an archive, a repository of tradition, cultural value, and urban distinctiveness. A denial of coevalness, such a move works to 'other' the walled city, reifying the differences between the *pols* and those areas west of the Sabarmati, which more closely resemble the imagined Euro-American urban ideal. (cf. Fabian, 2014 [1983]) The appearance of such lights among the tree-lined streets of these more recent neighbourhoods would have been unremarkable, tracking the influence and resources of their middle-class inhabitants. Encountered in the *pols*, however, the lights' apparent modernity was surprising, in tension with a spatial context coded as 'backward', and coinciding with an event that troubled my understanding of public and private space. Discounting the possibility that the lights' appearance might constitute an extension of formal municipal infrastructure to the city's *pols*, I too readily equated context with culture, fixing and naturalising both as immutable—the consequence of a stealthy inheritance of orientalising tropes and stereotypes. (cf. Said, 1979; Spurr, 1993)

This chapter's thematic concerns, and my wider argument, which turns on questions of materiality, movement, and context, are implicated in relations of whiteness. By starting with this account of disconcertment, I demonstrate how my efforts to explicate Ahmedabad's infrastructures risk being layered atop an orientalising vision that emphasises and naturalises difference between Indian lifeworlds and the Euro-American ideal. (Said, 1979: 43) Conscious of how race and gender articulate across a range of cases, over the following chapters, I show the pressing need to thicken, complicate, and critique the literature on infrastructure and sociotechnical change introduced in Chapter 2.

6.3. Wells, tanks, and cisterns

Sharing examples of water infrastructure, in this section, I follow Karen Bakker in asking how the relationship between humans and water is shaped and mediated by sociotechnical forms. Sharing encounters with a stepwell, rooftop storage tanks, and the appropriation and remaking of a dormant underground cistern, I explore how water infrastructures are implicated in the exercise of power and authority. (Bakker, 2012: 616). Remaining sensitive to water's specificity, as a non-substitutable flow essential for life, but variable in time and space (ibid: 617), reading across these cases shows how power, agency, and authority structure relations of mutability and obduracy.

6.3.a. Adalaj ni vav

In the village of Adalaj, Rudabai says a prayer, then throws herself into the stepwell. An edifice of sandstone, the structure is five storeys deep; an octagonal well shaft supported by carved columns. As she falls, time slows, thickening like syrup.[71] A stray dog watches, unseen, from a position at ground level, as two men climb the well's uppermost set of steps. Smartly dressed in shirts and slacks, it seems they are on their lunch break; caught mid-stride, one looks down at his phone.[72] The stepwell had been started by Rudabai's husband, Rana Veer Singh. As chief of Kalol, Singh had made much of his Vaghela ancestors, who had been the last Hindu kings to rule Gujarat before the Muslim conquest of the region. He had intended the well to be for the benefit of all; not just a source of water for drinking and washing, but a site for goddess worship, and a refuge from the heat, frequented by locals and travellers alike. The gift of water was a benevolent act and would be viewed favourably by the gods.

The sound of drums, as villagers gather at the compound's gates. A group of dancers, girls and women, detach themselves from the larger procession. Accompanied by a lone drummer, they enter the stepwell, performing a circle dance as an attendant lays a garland of flowers and curling wick of incense in one of the well's votive niches. The rest of the group continue along the road.[73] Rudbai remembers her first meeting with Mahmud Shah Begada, the Muslim Sultan of Gujarat. Her husband died on the battlefield, one of many Rajput chieftains to fall victim to Begada's military campaigns, as he sought to centralise control and assert his power over the region. Meeting with the widowed Rudabai, the Sultan was struck by her beauty, and insisted she marry him. She agreed, subject to one condition: first, he must finish building the stepwell.

Half-way down the steps, a group of Gujarati youths in waistcoats and sunglasses use the well's carved stonework as backdrop for a photo shoot; posing first with a MacBook, then stopping to put on a necktie or shiny suit jacket—part, perhaps, of some student project or new business venture.[74] As she falls, Rudabai feels the temperature drop. It's cooler in the lower depths, with a dank and musty odour. A camera flash reveals a family visiting from Chennai or Delhi or somewhere experiencing a sufficiently rapid

[71] This passage blends legend, historical sources, material evidence, and field notes for observations conducted over visits in 2015 and 2016, to emulate Walter Benjamin's 'colportage phenomenon of space' (cf. Von Vogt, 2015).
[72] From photo, 25 January 2015.
[73] From field notes, 25 January 2015.
[74] From field notes, 12 February 2016.

pace of change for ageing parents and their adult children to adopt entirely different modes of dress—generations separated by slogan t-shirts and a *salwar kameez*. Their laughter echoes in the dark.

In completing the well, the Sultan fulfilled his side of the bargain. Her husband's legacy guaranteed[75], Rudabai instead chooses *sati*, or suicide by drowning. But was this a decision made as she stood looking down the well shaft, or had it been her plan from the start? In these final moments, she cannot recall. Her body hits the water. Pigeons scatter, taking flight.

Rudabai's stepwell is set inside a gated compound on the edge of Adalaj, a town of 10,000 people, with Jain and Hindu temples, a mosque, and busy vegetable market. Fringed by trees, the stepwell is 75 meters long, laid out along a north-south axis, with a sunken octagonal well shaft in the north, now covered with a metal grill. Three entrances meet on a sunken landing, below ground level. From here, a stepped corridor descends five storeys, through richly decorated landings, whose columns stop the structure from collapsing under its own weight. Like the rest of Gujarat, Adalaj experiences two seasons; a wet, tropical monsoon, lasting from June to September, and a semi-arid season spanning the rest of the year. High humidity during monsoon, and the need for water collection in non-monsoon months, saw stepwells emerge as gathering places; a retreat for travellers and local villagers, with temperatures up to six degrees lower than that outside. (Jain-Neubauer, 1999: 4)

A locally situated response to seasonal water scarcity, the stepwell at Adalaj draws on a hidden underground aquifer. (Livingston, 2002; Pearson, 2016) Such aquifers are not simply natural underground tanks, but have a 'playful and irregular' form; an interplay of 'volumetric borders, suction and seepage' elided by the stepwell's monumental sandstone. (Ballestero, 2018) As subsurface water migrates, 'flowing into more open locations, saturating small particles, [and] pushing its way between sand grains' (ibid.), the structure relies on the presence of a fine silt to screen sediment, allowing muddy monsoon runoff to be stored as clear water underground. (Livingston, 2002: 10)

Construction of the Adalaj stepwell was started in 1498, by Rana Veer Singh, chief of Kalol, who traced his ancestry to the last Hindu kings to rule Gujarat before the Muslim

[75] Stepwell inscription: '[Queen] Rudaba … caused to be made the well in Adalaj in order that her (deceased) husband might attain to the world which is the abode of the gods.' (Commissariat, 1938: 242)

conquest in 1299. He intended the well to be for the benefit of all; not just a source of water for drinking and washing, but a site for goddess worship, and refuge from the heat —a tangible contribution to the public good, likely to please the gods. (Jain-Neubauer, 1999: 5) Prior to the stepwell's completion, this chief, Veer Singh, died on the battlefield, one of many killed by Mahmud Shah Begada, the Muslim Sultan of Gujarat. Meeting with Singh's window, the invading Sultan insisted she marry him. For the invader, this marriage was a way to secure his popular legitimacy; while for the widow Rudabai, insisting Begada complete this water source was a way to ensure her dead husband's immortality, in history and the afterlife. Once the Sultan fulfilled his side of the bargain, Rudabai threw herself into the well. That's the story, anyway.

Under British rule, many stepwells, such as that at Adalaj, were closed or shut down. One well near Veraval was filled with rubble after robbers were found using it as a hiding place. (Livingston, 2002: 142) Elsewhere, colonial authorities cast the structures an unhygienic source of infection and disease. (Krishnamurthy, 2016; Broich, 2017) By filling and sealing wells and tanks[76], the British hoped to change people's behaviour, with new discourses of 'safe' water justifying the replacement of local practices and sources with centralised systems operating at the town or city scale. (Broich, 2017: 360; Bakker, 2012: 618) Eclipsed by these 'modern' water supply systems, Rudabai's stepwell survives today as a monument and tourist site, its recognition by India's Archaeological Survey guaranteeing protection from encroachment or future modifications.[77] A sign at the site's entrance marks the stepwell as subject to the Ancient Monuments and Archaeological Sites and Remains Act (1958), which places stringent restrictions on construction in the vicinity—banned outright within 100m, and with interventions from 100-300m requiring permission from the relevant authorities.

Exploring the implications of this legislation, anthropologist Anand Taneja invites readers to imagine an invisible force field emanating from a disused mosque in an otherwise lively city,:

> As far as the force field goes, the landscape is permanently frozen; everything about it will remain exactly as it was on June 16, 1992, from now to the end of time. Not only can contentious temples not be built, but houses cannot add new rooms, shops cannot add new awnings, power lines cannot be laid, and new buildings cannot be built. The dark

[76] Small, rain-fed public reservoirs.

[77] Other stepwells in Gujarat have fallen into disrepair, clumsily renovated by locals, used as sites for waste disposal or open defecation, or encroached upon by houses and informal religious structures. (Krishnamurthy, 2016; Rahman, 2019)

> monument at the center is now a Medusa, petrifying everything that falls within its gaze. (Taneja, 2017: 245-246)

Rarely invoked in the years following its passage, enforcement of this ruling shifted after a BJP-led government assumed power in 1999. At this time, India's Archaeological Survey sat under the Ministry of Tourism and Culture, which was headed by Jagmohan, an ex-civil servant known for overseeing the large-scale bulldozing of Delhi's slums during the Emergency.[78,79] Under Jagmohan's leadership, the 'force field was activated' and became a terrifying new weapon in the arsenal of state authorities, enabling the demolition of shops and homes. (Taneja, 2017: 246) In May 2017, further legislative amendments granted the Centre additional powers to start construction within the 'prohibited area', arrogating to itself 'the power to choose the relation of the material remains of the past to infrastructural visions of the future.' (ibid: 276) Experts and commentators expressed alarm, seeing the influence of an increasingly powerful construction lobby.[80] (Aggarwal, 2018)

In my visits to Adalaj, Rudabai's stepwell was, to borrow the ASI's terminology, neither dead nor alive. Classified as a monument, the stepwell has been cast as a 'secular space of scopic pleasure', subject to the gaze of visitors and tourists. (Taneja, 2017: 23) Treated as a 'dead' structure by the authorities, the well is no longer used as a water source, and appears to have been removed from any material conversations of infrastructural call-and-response. (Smith, 2016) Seen as the deactivated remnant of a lifeworld erased by the British, 'devoid of religious life and significance' (Taneja, 2017: 18), the presence of sustained ritual practice nonetheless gestures to a surviving, if attenuated, religious functionality that has outlived the structure's use as a water source. (cf. Pinch, 2010: 80) Where other stepwells have succumbed to ruination, Rudabai's stepwell endures, protected from encroachment, demolition, or adaptive re-use by the instruments of a state that recognises its cultural and historical value. These surviving ritual practices rely on the stepwell's material persistence. The incense burns out, and the

[78] A 21-month period of authoritarian rule, spanning 1975–77, in which the Congress government of Prime Minister Indira Gandhi suspended elections, engaging in censorship of the press, imprisoning its enemies with neither charge nor trial, and engaging in programmes of slum clearance and coerced sterilisation. (cf. Jaffrelot and Anil, 2020, among others)

[79] An effort he described as a 'technological act transcending politics', but which later commentators have interpreted as an authoritarian experiment in 'Hausmannisation'. (Visvanathan, 1997: 7; Clibbens, 2014: 60-63)

[80] Speaking to the press, ASI officials claimed pressure for this change came when the body refused permission for a six-lane highway near the tomb of the Mughal emperor Akbar, near Agra, in Uttar Pradesh. (Venkat, 2018)

site's caretaker may, in time, clear the garlands and offerings, but as long as the stepwell stands, the believers will likely return.

6.3.b. Rooftop tanks

14 January brings Uttarayan, a holiday marking the transition from winter to summer. As the winds change, people take to Ahmedabad's rooftops to fly kites. In the weeks before, I see figures on the side of the road, winding lengths of brightly coloured cotton *manja*. Coated with tree gums and powdered glass, these threads are optimised for kite-fighting, with neighbours competing to cut each other's kite strings.

On the day itself, I head up onto the roof with an Ahmedabad-born friend, her husband, their infant son, and a pair of Chicago-based designers visiting the city. Invited to a Jain tenement in Khadia by a contact of this friend's parents, we find ourselves in the heart of the historic walled city.[81] There are several groups already up here; circles of friends and family, parents holding their infants aloft, all gazing up at the sky. Sunglasses and wide-brimmed hats, fingers bound with tape as protection from the *manja*. It is hot. The air is thick with kites of all sizes, decorated with ornamental fish, flowers, Disney characters, and corporate logos.

Settling atop some loft or outbuilding, I am granted an unimpeded view of the old city. Looking across the rooftops, I see three young men standing, shoulder-to-shoulder, on the platform atop a temple's *amalaka*.[82] Smiling broadly, they lean back, one thrusting out a selfie stick in a futile attempt to fit everyone in-shot.[83] In the background, hotel shingles and minarets. A tethered hot air balloon rises and falls, one of the attractions at Kankaria Lake, to the south. Down at street level, a cow reclines against a shining red Hyundai.[84]

Returning my attention to roof level, I take a moment to survey the rooftops' loose constellation of *things*. Scarfs and rucksacks, stacks of kites, spools of *manja*, boomboxes and Airtel-branded satellite dishes, wooden window shutters, loose roof tiles, metal railings, and white plastic lawn chairs. Flaking paint, a rusting bed frame, sheets of corrugated iron weighed down with bricks and lumps of slate. Concrete benches fringe the

[81] From field notes, 14 January 2016.
[82] The segmented stone disk topping a Hindu temple's main tower.
[83] From photo, 14 January 2016.
[84] From photo, 14 January 2016.

edge of a blue and white tiled mosaic floor, its pattern smudged with dust. A man holds a loudhailer at hip-level. Vine-like tangles of pipes, gutters, power cables, and spliced wires; snagging kite strings, secured with rope. Plastic water tanks, or *tanki*, are dotted throughout, branded with the logos of their manufacturers: Sintex, Omtex, Reno. A warning sign on a cell phone tower that sprouts, tree-like, from the centre of the roof: 'RF RADIATION! DO NOT TOUCH TOWER!' In front of its locked electrical enclosure stand a row of chai urns, a blue bucket, and a fast-depleting stack of paper cups.[85]

I wonder—were one to sweep away the mass-produced festival ephemera, those spools of Chinese-made *manja*, novelty wigs, and bright vuvuzelas, what would remain? The cables and pipes, certainly: critical infrastructure for the tenants below. The chai urns would go, but the water storage tanks would stay, despite their similar form; the latter plumbed into the pipe systems below. These plastic tanks smooth uneven patterns of water supply and demand, allowing households to adapt to a situation where the city only provides water between 6–8am. Ahmedabad's water supply is unmetered. With water tax included in annual property tax bills, affordability is not a primary concern. The main bottlenecks are poor water pressure and restricted hours. (Iyer et al., 2014) By using motorised and electric pumps to shift this two-hour allocation up into roof-mounted *tanki*, users are then able to tap this localised resource throughout the day.

Forming the material base of a strategy for managing an intermittent or limited water supply, home storage tanks are found in cities across India and the global south. In Mumbai, for example, users respond to a 'sump and pump' system, where the municipal corporation supplies water on a rotating basis, pressurising different parts of the network for fixed periods of time. (Björkman, 2015: 31) Water is stored for later use. A messy assemblage of pumps, tanks, pipes, and hoses collect as much as possible, then redirect it to 'various bathrooms, faucets and the kitchen throughout the day.' (Anand, 2017b: 98) Extending these practices, the rooftop *tanki* operates as a mediating technology, added to an existing system to modify its function and behaviour. (Furlong, 2011), Allowing its users to ignore or deviate from the city's schedule (Anand, 2017b: 98), the water storage tank facilitates the illusion of continuous supply, as might be delivered by a system adhering to the precepts of the modern ideal.

Part of the rooftop ecology of Ahmedabad's old city's, these plastic tanks invert many received assumptions about infrastructure, which originally denoted work

[85] From photo, 14 January 2016.

conducted *beneath* unlaid railway tracks, or undertaken *before* construction began. (Carse, 2017: 29) By contrast, *tanki* are both *above* and *after*. Raised high above their users, invisible from ground level, their use depends on gravity's pull. At the same time, as a mediating technology, *tanki* have stretched the outermost capillaries of Ahmedabad's existing municipal water infrastructure; bolstering the inherited system by mitigating the limitations of its intermittent supply.

The almost ubiquitous adoption of *tankis* problematises the bounding of Ahmedabad's municipal water supply system. Once added, these simple devices tend to remain stuck in place; differentiating them from the porous, shifting boundaries of more fluid or mutable entities. Although they provide an object lesson in how Ahmedabad's system falls short of the expectations of modern infrastructure, their widespread uptake brings users' experiences, if anything, closer to the normative goals of such an ideal. One could interpret the resulting water supply-storage hybrid as a *composite* infrastructure—bridging the formal and informal, permanent and temporary, municipal and domestic. Such systems composition and bounding are, however, far from straightforward; a preoccupation of researchers, rather than the city's water users.

6.3.c. The haveli's cistern

The *haveli*'s *tanka*, or cistern, is under glass. A plastic pipe hugs the side of the five-foot deep shaft, the water level clearly visible below. This point of access is in the *haveli*'s main hall, a room with benches, a coffee table, throw cushions, and shelves of *lotas.*[86] Parallel with a wooden swing seat hanging from a crossbeam, the lip of the *tanka* juts up, raised above the tiled floor, so no water can accidentally flow in. Where many similar such *tankas* have long fallen into disuse, with most of the 8000-10,000 estimated to have existed in Ahmedabad now bricked up, this example continues to provide the household's water. As someone sleuthing for infrastructural forms, I am delighted.

Learning of my research interests over a meal of *dhal* and *roti*, my host, Rajiv, invites me to join an afternoon walk with a group from a trade union for women working in the informal sector. Their visit is the prelude to a longer, in-depth survey of one or two of the walled city's *pols*, providing evidence for a proposal they hope to shop around for grant

[86] Round water pots, typically made from brass or copper.

funding. All women, the group comprises a union representative, an architect, strategist, and a project manager responsible for mapping and surveying.

With a ready audience, Rajiv showing off, clearly relishing his status as a big man in the community, an agent of regeneration and bulwark against further decay. As explained to this larger group, the decision to open and return the cistern to use, installing a pressure pump, allowed him and his team to duplicate the function of the existing rooftop *tanki*. This, in turn, freed up space for a roof terrace; a feature appealing to foreign tourists, and source of additional income. The women seem impressed by his description; as he heads back inside to grab a bag, one turns to another, saying: "I wanted you to hear it from his own mouth."

Figure 2. *Tanka* entrance and *boiya* at a private residence in Khadia, Ahmedabad, 15 January 2016.

A *tanka* is an underground cistern that would, historically, have stored the water collected by a household's rainwater harvesting system. Sunk beneath a kitchen or hall, as at the *haveli*, such cisterns were walled with stone blocks in lime mortar, lined with plaster, and waterproofed with *khari*—a herbal sealing agent capable of filling fissures and

preventing bacteriological growth. (Cama, 2019: 79) The bottom of the *tanka* sat below the house's lowest point, its base sloping to a sump under the point where the water was to be drawn. (ibid: 81) Shielded from direct sunlight, the *tanka*'s lime mortar kept the water pH balanced, and free from contamination. Filled with rainwater from the building's roof, the *tanka*'s use was governed by social and astrological norms. Early in the monsoon, glasses of water left outside would be inspected for their clarity, with the water's smell and taste determining when to start collection. (ibid: 79) The system incorporated multiple filters, and pipes converged on the *boiya*, a copper colander covered with white muslin (Figure 2). (ibid: 80) With sluices to control flow, water would not be directed into the cistern until the roof was clean. (Gillion, 1968: 131) Allowing rainwater to be collected where it fell, it was hoped these household systems would minimise contaminants, keeping the water pure and suitable for potable use.

Cultural historian Shernaz Cama attributes the presence of *tankas* in Gujarat to the state's long-established Parsi Zoroastrian community, for whom their use was 'almost a religious ritual', symbolising respect for water. (Cama, 2019: 79) In Ahmedabad, they were also as a situated response to cyclical droughts experienced roughly once every five years. (Amiraly et al., 2004: 10) An important source of water both for their owners and the surrounding community, larger *tankas* often reached depths of 8-10 feet, easily big enough for people to walk about inside. (ibid: 33) Although many were old, cracked, or contaminated, even prior to the extension of piped water supply, they were seen as providing the best water available in the city. (Gillion, 1968: 131) Citing health risks, colonial authorities outlawed the use of *tankas* in 1943; but there were, reputedly, also concerns that freedom fighters and independence agitators may have used them as hiding places.[87] (Adhyaru-Majithia, 2011)

After decades of disuse, some efforts at *tanka* research and restoration were made in Ahmedabad in the 1990s and early 2000s, bringing 10 tanks in Khadia back into use. Initiated by a community history group, with the support of the city government's heritage cell[88], a pilot project supplied a team of cleaners with tools and equipment; an exhaust fan for ventilation, rope ladders, lighting, and a submersible pump to remove silt and stagnant water. Water samples from 11 *tankas* were sent for lab analysis, and found to exceed WHO standards, free from bacteria, and suitable for cooking and washing utensils. (Das, 2000)

[87] In some rare cases, a secret room, or *chor-khana*, was built into the cistern's walls, sitting above the water level.
[88] A dedicated unit of the municipal government, established in July 1996.

Even with resourcing and institutional support, however, this pilot failed to scale up, leaving little lasting impression.

With no obvious links to these earlier efforts, the conversion of the *haveli*'s *tanka*—reworking an old, inherited technology to support new use cases (Howe et al., 2016: 7)—appears anomalous, a one-off case disconnected from wider ecologies of culture and practice. Unlike those few households that continued to maintain and use their *tankas* as intended, the case of the *haveli tanka* was not that of a sociotechnical 'living fossil', an isolated space where practices persist long after having been abandoned elsewhere. (Shove and Pantzar, 2005: 60-61) Severed from any building-scale rainwater harvesting system, this was, instead, as Rajiv explained, a case of a disused *tanka* being retrofitted to store water provided by the city authorities.

Despite this explanation, and Rajiv's words to those union researchers, there remained some ambiguity around the cistern's relationship to the municipal water supply. On one occasion, I found a water tanker parked out front, its hose snaking into the *haveli*. Active in Ahmedabad since the mid-1980s, private water tankers are used by government offices, construction companies, and users without a reliable water connection, but also, increasingly, by members of the urban middle classes looking 'to top up their supply' (Button, 2017: 111). These tankers operate mostly outside the municipality's limits, extracting water from rural and peri-urban wells, or buying it from farmers.[89] (Amiraly et al., 2004: 29) While municipal supplies are suitable for drinking, water provided by tankers is typically dedicated to non-potable use. In the *haveli*, I noticed multi-litre plastic bottles in the fridge, their seals broken, and a tangle of pipes around the kitchen sink. These details suggested the presence of a powered UV water filter, a technology widely advertised in newspapers and the city's home appliance stores.

The union group's walk through the *pols* end at the City Heritage Centre.[90] At the time of our visit, the centre employs a handful of staff, who work from an office in one of the finished rooms of a large and handsome 250-year-old building, being restored as a demonstration project.[91] Four storeys high, the *haveli* had previously been occupied by six different tenants, and, at the time of its acquisition, was in an advanced state of disrepair.

[89] Contributing to the rapid depletion of groundwater.
[90] Envisaged as a 'single-window solution' for 'technical advice, assistance in legal and financial resources, and drawing up economic sustainability plans for … heritage properties' (Nayak, 2017: 218).
[91] From field notes, 31 January 2015.

Rajiv and his colleagues assembled a construction crew, taking out ads in newspapers and pursuing word-of-mouth recommendations to find the necessary skills and expertise, retaining a conservation architect and heritage carpenter; and roping in European restoration experts to help transfer knowledge gained from working with similar buildings in southern Spain.[92]

With this as his operating context, my preoccupation with the *haveli*'s *tanka* sparks Rajiv's interest. He floats the idea of enlisting me to find ways of reconnecting heritage properties' *tankas* to their rainwater harvesting systems; seemingly unaware of similar such attempts by the Khadia history committee and AMC heritage cell, some years earlier. Still in my first months of fieldwork, and wary of narrowing my focus too early, or allowing myself to be monopolised by a particular set of interests, this plan doesn't pan out—but looking back later, I find myself wondering, what if it had?

Although this may appear as a missed opportunity, Rajiv's stated support for *tankas* and rainwater harvesting closely tracked his role as a developer pursuing a programme of enterprise-led community development. As part of this agenda, any attempted 'revitalisation' of the walled city's *tankas* would have been justified less by their utility than their 'Gujarati' character; a point of differentiation supporting Ahmedabad's claim to a distinctive and valuable cultural and material heritage. Contrasted with his entrepreneurial ambitions for the *haveli* and City Heritage Centre, it is, perhaps, possible to speculate about a situation in which that earlier city-backed pilot had succeeded, with research, documentation, and local citizens' involvement in cleaning and restoration providing a transferable model for other cities and local governments. (Naik, cited in Parekh and Kaushik, 2005)

What would it have meant for this to succeed? Beyond the 10 *tankas* restored in the pilot, 60 more were identified, with the Khadia history committee exploring local politicians' grants as a source of funding for further restoration and repair. (Siddiqi, 2000) A survey of two *pols* in winter 2001-02 found more than half of households had a non-operational rainwater harvesting system, in addition to the 1 in 6 who were already users.[93] (Amiraly et al., 2004: 49) A more successful pilot could, perhaps have built on this existing user base, cultivating the *tanka* as something able to compete with other sources in regular use.

[92] From Rain (2011).
[93] Albeit mostly in exceptional circumstances, such as weddings or celebrations, religious rituals, under conditions of water scarcity, or during civil works. (Amiraly et al., 2004: 50-51)

Any attempted reactivation of the *tanka* systems for rainwater harvesting would, however, have relied on the resurrection and reproduction of unfamiliar user practices. In addition, any the system would only be able to be reproduced in places where there were already *tankas*, with a maximum upper limit imposed by the estimated 8000-10,000 once in use. (Gillion, 1969: 131) Lastly, attempts to popularise and scale up rainwater harvesting systems would be sensitive to structures of cultural significance and meaning. In an absence of 'widespread stabilised representations' (Smith and Raven, 2012: 1027), proponents would have to challenge established social norms, contending with inherited portrayals of rainwater harvesting and tank storage as backward, pre-modern, and at odds with hygienist discourses. (Bakker, 2012) Without institutional support, the perceived inconvenience of practices conflicting with potential users' existing habits would have slowed efforts to develop *tanka* use as a scalable innovation. (Smith and Raven, 2012: 1026) At the same time, the material obduracy of existing buildings would have prevented the construction of new cisterns, further limiting the model's improvement and wider uptake.[94]

With multiple obstacles to any systematic revitalisation of *tanka* use, my encounter with the retrofitted tank at the *haveli* revealed the separation of user practices from a fragmented material form. Outliving the rainwater harvesting system once integrated into the building's structure, the *haveli*'s underground cistern appeared as the material remains of a larger fossilised or dormant infrastructure system, available for re-scripting and reuse. (Shove and Pantzar, 2005; Maller and Strengers, 2015) As reworked by Rajiv and his team, this *tanka* supported their 'co-production' of a continuous water supply for the benefit of the *haveli*'s guests; a 'pragmatic choreography' of multiple water sources that mostly succeeded in mimicking the experience of the modern infrastructural ideal. (Button, 2017: 103) As part of this effort, the cistern's 'reclamation' may have removed the *haveli*'s in-building water source from view—releasing space for the boasted roof terrace—but the pressure pump remained clearly audible; its clicks and *shlumps* belying this otherwise effaced co-production; a regular machinic heartbeat for the duration of my stay.

[94] Rainwater harvesting has since been widely adopted in new property developments in Ahmedabad, with state development regulations mandating all buildings larger than 1000m sq. to include a rainwater tank, and facilities for percolation and groundwater recharge.

6.3.d. Discussion

Focusing on water, this section took three sets of observations as the foundation for a mapping of mutability and obduracy in Ahmedabad. Each of these cases represents a deliberate, situated material intervention, regularising water provision by, variously, tapping a subsurface aquifer, mitigating the intermittencies of an inadequate 'public' infrastructure, storing and maintaining the purity of collected rainwater, and concealing the multiple sources involved in co-producing a continuous water supply.

Often contingent on their material environment, these cases share a resistance to wider mobilisation and scaling. Most obviously, the Adalaj stepwell's infrastructural function turned on its geophysical siting, atop an aquifer. As a spectacular, monumental demonstration of kingship, a local user base rendered it unsuitable for reproduction elsewhere.[95] The proliferation of *tanki* rooftop water storage tanks in Ahmedabad stands as a situated response to the failures of the AMC's water supply system. Often improvisational in nature, these infrastructural supplements blend mass-produced, commercially available products and acts of *jugaad*. Finally, efforts to renovate Ahmedabad's many *tankas*, as a prelude to returning them to everyday use, have been stymied by discontinuities in rainwater harvesting practices and institutional knowledge. In this, Rajiv and his team's repurposing of the *haveli*'s cistern for general water storage may have been opportunistic, motivated by a desire to boost revenue, but he proved able to overcome and redirect the structure's material resistance where more systematic, top-down efforts by city government and civil society had been unable to do so.

In this section, a focus on water supply and storage revealed the variable manifestations of mutability and material resistance, as something often independent of their technical function. Focusing on marginal, user-driven, and atypical cases, I showed how obduracy can be, variously, a product of materiality, inertia, or the demise of supporting systems and social practices. Bolstered by size, resistant materials, or regulatory protection, 'dead' or 'dormant' materiality can outlast a given system's technical function, providing an attenuated locus for ritual practice, or a scaffold for creative re-use. At the same time, the operation and use of these marginal systems are striated by politics, religion, household dynamics, user agency, and social practice. In the

[95] The stepwell site also contains the tombs of six stone masons who worked on the structure; reputedly, after its completion, Mahmud Shah Begada asked if they could replicate a similar such structure, and, when they said they could, had them executed.

following section, I shift my focus from water provision to questions of transportation and mobility, to show how different, overlapping systems interact.

6.4. Buses and bicycles

In the last part of this chapter, I take the relationship between MYBYK, a bicycle-sharing service, and Janmarg, a bus rapid transit system (BRTS), as a strategic site to investigate mutability, obduracy, and infrastructural 'stickiness'. Both systems are successful examples of urban sociotechnical change—one led by the state and municipal government through a public-private partnership, the other an entrepreneurial small business. Unlike the previous section, which focused on situated and supplemental water supply systems, these examples are more recognisably 'infrastructural'. My encounters with the two services reveal how new systems, led by business or government, have different degrees of mutability, and how they reckon with existing elements of the built environment.

6.4.a. MYBYK at Shivranjani Cross Road

It is a Thursday afternoon in February, and I am on foot, following Satellite Road[96] back to the city centre. Earlier that day, I met an employee of an NGO that had been involved in a slum upgrading and community infrastructure pilot in the 1990s-2000s. With the project now long completed, my designated contact busy with other work, and finding little evidence of any enduring institutional memory, I stop at a café on the way home—somewhere to consider my next moves, while leafing through a glossy copy of the organisation's annual report.

Finishing my coffee, I settle the bill and press on, heading east. Having walked this route many times before, on this occasion, I am thrown to see a series of cabins mounted beneath the split flyover at Shivranjani Cross Road (Figure 3); a detail that had previously eluded me.[97] With few road markings to keep order, the intersection of two roads and a dedicated bus corridor are marked by traffic lights and a raised metal police post. Named for Parsi war hero Field Marshal Sam Manekshaw, an official designation long fallen into

[96] Named for the city's involvement in the space sector, with offices of ISRO, the Indian Space Research Organisation, to the west.
[97] From field notes and photos, 5 February 2016.

disuse, the flyover's concrete piles are stamped with the logo of AUDA, Ahmedabad's urban development authority.[98] Rows of identical flyers are pasted at eye-level; printed adverts for guest lodgings, student visa agents, tutoring for the Gujarat Public Service Commission exam. Larger colour posters reproduce the likeness of some political candidate. A small retail unit opens straight onto the intersection, bearing the sign of R. Kumar Opticians.

The cabins are a terminal for a for-profit bike-sharing service: MYBYK. Roughly the size of two shipping containers laid end-to-end, the cabins are grey, with a roll up steel door and grilled metal ramp leading down to the street. A single bicycle hangs from a stand bolted to the front of the cabin, its sides painted the same shade of green as the company logo. Signs and slogans: 'Yes, you can keep it at home.' 'How do I get a MYBYK?' 'Call or WhatsApp us on—'

Figure. 3. MYBYK cabins at Shivranjani Cross Road, Ahmedabad, 5 February 2016.

In this moment, I experience that same sense of disconcertment described at the start of this chapter. (Verran, 2001) For me, bike-sharing and cycle-hire were associated with Transport for London's cycle hire scheme, which had been operating since 2010.

[98] An entity with responsibility for the planning and future development of the area falling outside of the Municipal Corporation's purview, beyond current city limits.

Stumbling across a similar such system, offering use of a shared bicycle fleet 'as-needed' (Shaheen et al., 2010: 159), was a jarring experience, unsettling many of my preconceptions about Ahmedabad's residents and their mobility preferences. The encounter challenged a denial of coevalness grounded in diffusionist conceptions of innovation and technological change. The presence of a visibly modern service, contingent on a digital fleet management platform, seemed to breach the linear trajectory of progressive development—appearing, somehow, ahead of schedule.

Looking, later, at the service's website and media coverage, I see that MYBYK received early support from the AMC and former Chief Minister of Gujarat, Narendra Modi. The service started in 2014, with the city government guaranteeing space for cabin terminals for five years, co-located with bus stops serving the city's Janmarg BRTS. (Sengers and Raven, 2015: 172) Since its 2009 launch, Janmarg has been hailed as a model 'best practice' for cities elsewhere in India and across the global south. Its buses appear on the city streets as sleek, modern marvels, with a 'sheen of new paint, … digital sign boards and pneumatic doors' allowing the system to symbolise a kind of 'hyper-progressive' Gujarat. (Shah, 2015: 112) Embodying a kind of partial, semi-localised neoliberalism, Janmarg has helped position Ahmedabad as a 'storefront' of modernity (Paget-Seekins, 2015); one of several high-profile infrastructure projects promoted by state and city governments at public-facing events, in Gujarat and overseas. (Rizvi, 2014: 66)

6.4.b. Janmarg, the People's Way

To qualify as a BRTS[99], a system such as Ahmedabad's must include at least 3km of dedicated bus lanes ('busways'), with off-board fare collection and platform-level boarding at bus stops, and buses granted priority right-of-way at road intersections. (ITDP, 2016) In Ahmedabad, the Janmarg BRTS was the outcome of a comprehensive mobility study, conducted by state and local government in response to a perceived crisis linked to rising air pollution, traffic congestion, and road fatalities. (Wilson, 2013: 73) Aligning with state and city initiatives[100], the study received strong institutional support, and was allocated funding under the Indian government's flagship Jawaharlal Nehru National Urban Renewal Mission.

[99] Based on a standardised global model designed and promoted by the New York-based Institute for Transport and Development Policy (ITDP).
[100] Including Gujarat's Year of Urban Development, an 'Accessible Ahmedabad' vision, and the National Urban Transport Policy.

Given the name 'Janmarg', Gujarati for the 'people's way', the BRTS was promoted as 'a system that would carry all the citizens of Ahmedabad, in safety and comfort, and at relatively high speeds.' (Wilson, 2013: 82) Ubiquitous across the project's advertising, signboards, and physical infrastructure, the 'Janmarg' name and branding were used to project an everyman's image. (Rizvi, 2014: 67) Since 1947, AMTS city buses had been Ahmedabad's only public transport service. With the city's inhabitants already accustomed to bus mobility, policymakers felt a bus-based system would encounter less public resistance. Compared with light rail or an urban metro, BRT was cost-effective, flexible, expandable, and able to be rapidly implemented. (Rizvi and Sclar, 2014: 198-199) Construction started in October 2007, and Janmarg's first routes opened to passengers two years later, in 2009.

Janmarg has been built in several stages since 2009, with incremental construction creating opportunities for learning and improvement. (Rizvi and Sclar, 2014: 200) The project's developers organised stakeholder meetings, workshops, free trials, and user satisfaction surveys to enrol and educate would-be users. (Wilson, 2013: 81) Less familiar elements of the system—including real-time information systems, automated doors, escalators[101], and dedicated busways—had to be introduced to would-be users, most of whom were members of low- or middle-income groups. (ibid: 74) Following ring-radial roads inherited from the medieval city, the Janmarg network comprises a 'complete ring encircling the city centre, with corridors radiating out to the city limits' (ibid: 78-79). An initial stretch of 18km, tracing a less congested route, was supplemented by a further 27km in 2012, including more difficult stretches of roadway. (ibid: 77) Designs for the first corridor went through multiple iterations, with debates over the optimal width of footpaths, cycle tracks, and bus lanes, and their relative positioning. The developers conducted experiments with AMTS buses to establish an appropriate width for the bus lanes, which were expanded from 7m to 7.3m. (Gautam et al., 2014: 40)

By the time of my research, in 2015–16, the Janmarg BRTS included 89km of busways, flanked by pedestrian and cycling facilities, new street lighting, pavement improvement, parks and landscaping, and new roads, flyovers, and footbridges. (Wilson, 2013: 79) In reconfiguring the streetscape, efforts were made to accommodate or relocate approximately 200 religious structures which fell within the development. Two Hindu temples and a Muslim memorial had to be directly incorporated into BRT route planning.

[101] For an account of the arrival of the first escalators in Ahmedabad, in August 2001, and the excitement over this 'metropolitan' marvel, see Bekkers (2005: 15–16).

(Kadri, 2010) Encroaching into the Narol-Naroda bus corridor, a temple of Radha Krishna required developers to create a public plaza, merging the cycle track with a widened pedestrian footpath. (Gautam et al., 2014: 58) Tracking efforts to accommodate 'specific site contexts' (ibid.), these and other exceptions to the codified design typology became a 'kind of tribute to enduring tradition within progressive urban development.' (Kadri, 2010)

Such accommodations were not restricted to religious structures. In Ambawadi, a bronze statue of Rani Lakshmi Bai, atop a rearing horse, was retained by incorporating a park in the median between busways. The widowed queen of the princely state of Jhansi, the Rani played a key role in the 1857 Indian Rebellion, and appears in contemporary nationalist discourse as a 'forerunner of Indian freedom' (Singh, 2014: 3; cf. Chatterjee, 1993a; 1993b). Resisting relocation, the tweaked design allowed Janmarg's busway to bend around the sword-wielding Rani's frozen figure, providing space for pedestrian zebra crossings and a regional bus interchange. (Gautam et al., 2014: 117) Janmarg's project documentation also includes the example of electricity pylons bearing high-tension lines, the relocation of which were judged as prohibitively expensive. Again, planners tweaked the BRTS design to accommodate the inherited features (Gautam et al., 2014: 72), splitting road traffic to one side of the pylon, and service traffic and cyclists to the other. In a third example, plans for a raised busway around a railway station at Kalupur, made to avoid obstructing limited cross-track road connections, was blocked by India's National Monuments Authority, who cited the density of protected archaeological structures in the area. (Gautam et al., 2014: 90)

In these cases, religious structures, a nationalist landmark, and key elements of an electricity transmission network resisted relocation, forcing the reconfiguration of otherwise fixed design protocols—while a density of state-protected religious structures repelled a planned flyover. Proving Anique Hommels' account of the recalcitrance and obduracies of the urban built environment (Hommels, 2005), these examples together map the variance of this material resistance. In each case, resistance or obduracy was produced by the friction between different social and material forms. The inherited forms that most strongly resisted Janmarg's urban reconfigurations were those that overwhelmed planners' ability to locate critical intervention points or pre-empt opposition; embodying the entanglement or interplay of a complex—or 'seamless' (Hughes, 1986)—combination of social, technical, religious, cultural, symbolic-discursive, infrastructural, and legal-governmental factors. Unlike historical 'grand plans', which

relied on state patronage or the fiat of rule, Janmarg had to be sensitive to the specificities of Ahmedabad's existing urban sociotechnical landscape. In this, it succeeded by capitalising on inherited structures, such as the city's ring-radial road structure, while a staggered roll-out created opportunities for iteration and social learning.

6.4.c. A meeting at Parshwa Tower

MYBYK's office is on the fifth floor of Parshwa Tower, out west near the ring road, in the city's Bodakdev neighbourhood.[102] Spying the building from across a vacant lot, I am struck by the unlikely combination of tinted glass, art deco cornices, and fluted neoclassical columns. AC units puncture the façade, wires and cables fanning out from the roof, a spider's web of connections to nearby buildings. Other tenants include a recruitment agency, business consultants, software engineers, a local broadband provider, and a start-up developing naturalistic text-to-speech translation for English and Hindi. Arjit Soni, MYBYK's founder, is in his late twenties, solicitous and smartly dressed, with the forward momentum of somebody already anticipating criticisms he's heard many times before. Trained first as a chartered accountant, Soni spent three years studying in Mumbai. In what is clearly intended as MYBYK's origin story, he begins by describing how, in navigating that city's congested transport system, he took it upon himself to buy two bicycles; one for the journey from his hostel to the railway station, and another for the final leg, from the station to his office. Flagging the intractable difficulties of the 'first and last mile', this anecdote lays the groundwork for him to present MYBYK as a solution.

Sharing an entrance with what I take to be his family's accounting firm, Soni's office is littered with certificates and awards. As we talk, he stands to use a whiteboard, sketching diagrams of user journeys, the MYBYK network's structure, the weaknesses of statistical data, and so on. At the time of our meeting, MYBYK has been operational for a little under two years and has six terminals located at some of the busiest stops on Ahmedabad's Janmarg BRTS routes. Most are in the west of the city, following the dedicated busway down National Highway 228. The company has 16 employees and has roughly 1000 regular users.

Soni is careful to stress the importance of a sustainable business model. "Even if you're operating as a non-profit, you need to think about profit." Without a stable

[102] From field notes, 4 March 2016.

foundation, he explains, organisations are left vulnerable to the whims of their donors. Hearing this, I am surprised by Soni's open admission of how MYBYK benefited not only from the support of investors, the AMC, and manufacturer Hero Cycles, but also Narendra Modi, in his capacity as Chief Minister. Seeing a video of Modi speaking to an audience of chartered accountancy students in Ahmedabad in 2013, Soni noted the open invitation for students and qualified accountants to contribute their ideas, and reached out. Modi was familiar with bicycle-sharing, have encountered a similar scheme on an official visit to Beijing, and pledged his support for the enterprise, using his executive authority to fast-track a MYBYK pilot.[103]

Since Modi's election as prime minister, lukewarm support from Ahmedabad's city authorities have hindered Soni's plans to grow the business. MYBYK is privately financed, and, having survived the 'bootstrapping' required to build a base of demand, he is now looking to finance the system's expansion. As well as financial constraints, there are also pressing physical obstacles to further growth. Where most existing MYBYK terminals have been squeezed into the space beneath flyovers, few suitable locations now remain. As such, any expansion is contingent on a more dramatic, resource-intensive reconfiguration of the existing streetscape—something all but impossible without active municipal support.

Sharing his own experiences commuting by bike over the past nine months, Soni is quick to dismiss my questions about safety: "Bikes aren't any less safe than two-wheelers.[104] Traffic here may be dangerous, but we're used to it." Instead, the pressing challenges are weather and climate, particularly the heat of the summer months, when otherwise enthusiastic users weigh cycling against the respite of a vehicle with its own AC. Citing the growing presence of ride-hailing services Uber and Ola in the city, Soni wishes taxis and other forms of paratransit had greater support for bike racks; making it easier to reconcile regular bike use with an unpredictable work schedule. Reflecting, later, on how his experience compares with that of the typical MYBYK user, I wonder if this is a veiled expression of his frustration with MYBYK's high level of dependency on the city's BRTS.

With preferred strategies for MYBYK's expansion blocked, at least in the short term, Soni wonders if additional private funding could support research and development—though, when pressed, he remains vague on what this might entail. The system is not yet

[103] See Vardhan (2014).
[104] In this case, motorbikes.

automated; although the bicycles are tagged with a MYKEY electronic identifier, the network's terminals are crewed, needing employees to check bikes in and out with an NFC-enabled phone.[105] Citing his long-term goal to replace terminals with a dockless 'smart bike' system enabling users to unlock bicycles with a phone app, Soni concedes that even this would not be as 'frictionless' a user experience as he might hope. Technology can replace people, he says, but it cannot solve the problem on its own.

Optimistic and speculative, Arjit Soni's explanations of MYBYK closely tracks Lily Irani's figuring of the Indian entrepreneur as an 'instrument of development', channelling whatever resources he can muster 'into the pursuit of entrepreneurial experiments' (Irani, 2019: 1). In our meeting, as in press interviews, Soni is quick to project a model of entrepreneurial citizenship in which an individual's grit, civic interest, and appetite for risk are sufficient to overcome any social or material resistance. Despite MYBYK's origins in the inertia of Mumbai's metro and railway systems, Soni's plans initially assumed the 'almost infinite malleability' of Ahmedabad's existing urban built environment. (Hommels, 2005: 323) The experience of bootstrapping MYBYK, however, proved more difficult, with Soni and his colleagues having to negotiate the opportunities and limitations of political patronage, and a rigid, stabilised streetscape.

When we met, Soni described how MYBYK had benefited from the support of a range of actors, including the early patronage of Narendra Modi. In classical anthropological studies, patronage is portrayed as a retrograde or ancillary social institution, denoting a relation of inequality between two people, one of who can mediate access to desired resources. (Pilavsky, 2014: 5) With MYBYK not contingent on government financing or endorsement, this example diverges from accounts of party clientelism or election 'freebies'. Although the support of the Chief Minister allowed MYBYK to bypass certain institutional barriers to entry, Soni's position as a young entrepreneurial subject complemented Modi's moves to legitimise the greater involvement of private enterprise in service provision. (Ong, 2007; Jaffrelot, 2019; Irani, 2019: 24) The service also provided a conspicuous, easily mobilised success story of the AMC and state government's environmental credentials (Modi, 2011), and support for SMEs, startups, and entrepreneurs.

[105] Near-field communication, a technology enabling two electronic devices to establish communication based on proximity; commonly used in contactless and mobile payment systems.

Following Modi's tenure as Chief Minister, MYBYK's status as one of his pet projects proved as much a liability as a benefit, leaving Soni stonewalled by the municipality. Although it is difficult to assign causality, MYBYK's origins and early development bear the imprint of practices of *jugaad* and entrepreneurial bricolage. (cf. Sekhsaria, 2013; Rai, 2019; Baker and Nelson, 2005) Soliciting support from early investors, his family's accountancy firm, bicycle manufacturer Hero Cycles, the Chief Minister, and the AMC, Soni refused to enact resource limitations as he built his business. Leveraging community ties, his capacity to labour, and even his political hope (Irani, 2019: 1), he constructed an idiosyncratic resource environment that granted access to financing, a fleet of bicycles, and enabled him to co-locate MYBYK terminals with Janmarg's bus stops. Having relied on bricolage and *jugaad* to grow the early business, MYBYK struggled with later path-dependency, assuming a structure and identity that isolated the firm from more lucrative markets, in turn slowing its path to profitability. (Baker and Leson, 2005: 349) At the same time, Modi's departure from office deprived Soni and his colleagues of support. Stymied by the material resistance of a rigid, obdurate streetscape they could no longer overcome, the removal of this key patron left MYBYK little opportunity for further growth within Ahmedabad.

With the built environment as a renewed obstacle to MYBYK's expansion, Soni falls back on technology to 'leapfrog'[106] the problems precipitated by a withdrawal of political patronage. His remarks on smartphone apps and near field communication anticipate a 'fourth-generation' of dockless bike-sharing services that did not yet exist. (Shaheen et al., 2010) Sharing plans to free the service from its dependence on physical terminals, Soni hoped to overcome the institutional and material obstacles to MYBYK's scaling. Embracing technological solutionism, this strategy pushed the limits of possibility. (Morozov, 2013) Although a dockless, app-based service might remove the need for staffed terminals, it would require significant investment in R&D and a sustained street-level presence for troubleshooting and fleet management. Cited as a way of overcoming material obduracy, this imagined dockless system would have done little to address the social resistance of the city's established mobility practices, and local framings of the bicycle as an unsafe, backward technology.

[106] See Philip (in Greenspan et al., 2016): p. 256.

6.4.d. Framing MYBYK

Taking the interface of Ahmedabad's Janmarg BRTS and MYBYK bicycle-sharing service as a strategic site to investigate the variable obduracy of urban infrastructures, the preceding sections reveal three salient technological frames. (cf. Bijker, 2010) Firstly, how MYBYK was sold to would-be users, as an *innovative solution to the first and last mile problem*. Secondly, how MYBYK was treated by the Chief Minister and city government, as a *de facto mediating technology* (Furlong, 2011), extending and modifying Janmarg's performance, while burnishing the city's environmental and development credentials. Lastly, how Janmarg was perceived by Arjit Soni and his backers, as a *protective space* to pilot and develop the MYBYK service, supporting its future growth. Divergences in these frames can help explain Soni and MYBYK's difficulties in growing the enterprise; offering fresh insight into the relative mutability of different infrastructures and urban systems.

The first of these three frames reduces MYBYK to its technical function, casting the service as an innovative solution to the first and last mile between home and public transit, and between public transit and the workplace. (Shaheen et al., 2010: 159) In Ahmedabad, this problematisation of the 'first and last mile' contrasts Janmarg's dedicated busways, which offer smooth, reliable, high-speed mobility between stations, with the heterogeneous traffic and congested streetscapes that dominates elsewhere. (Wilson, 2013) Positioned as a solution to this gap, the green MYBYK bicycle replaces the auto-rickshaw, an idiomatic form of Indian paratransit providing flexible 'contract carriage' services.[107] Clean and modern where the auto-rickshaw is backward, 'Oriental', and prone to overcharging passengers (Harding et al., 2016), this frame positions MYBYK favourably in a hierarchy of value. A product of Soni's entrepreneurial efforts, MYBYK contains the promise of scaling; capable of transcending the specificity of Ahmedabad's culture and built environment, and generating value for users and investors by meeting unserved needs. (Irani, 2019: 7)

The second frame cast MYBYK as a 'bolt-on' complement to the Janmarg BRTS. Held by those state politicians and city officials who patronised Soni and his colleagues, this cast the bike-sharing system as a mediating technology; a relatively small, low-cost addition to an existing infrastructural network. (Furlong, 2011: 460-461) Those holding this frame saw MYBYK fulfilling a similar role for the Janmarg BRTS as that of households' rooftop water tanks for the AMC-provided municipal water supply.[108] In both cases, the

[107] For more on auto-rickshaw mobilities, see Chapter 5; pp. 85–87.
[108] See pp. 129–130.

addition modified the functionality of existing infrastructure, revealing the potential malleability of systems that would otherwise have resisted change. Diverging from other mediating technologies cited by Kathryn Furlong, MYBYK succeeded not by dampening the consequences and externalities of an existing system (Furlong, 2011), but rather by overcoming its shortcomings—in this case, the unserved first and last mile of a user's journey.

The third frame identifies Janmarg as a protective space for the MYBYK service. This frame positioned the BRTS as a physical and institutional platform for innovation; shielding MYBYK from the pressures faced by similar initiatives elsewhere. By allowing MYBYK to piggyback on Janmarg's existing infrastructure, politicians and officials guaranteed the service's exposure to a ready user base of bus passengers, while circumventing many of the barriers to 'embedding' bike-sharing terminals in an obdurate urban streetscape. (Hommels, 2008) An opportunistic use of existing space, rather than something actively designed, this preferential access was nevertheless able to shield, nurture, and empower Soni's innovation. (Smith and Raven, 2012) Descriptions of MYBYK as a 'pilot' identified the service as undergoing a phase of open-ended experimentation, exposing the service to a limited audience to identify faults and gauge user acceptance. Implicit in this frame was an expectation of future growth. Co-locating MYBYK terminals with Janmarg bus stops would improve the service, rendering it more competitive with other forms of paratransit. The system would then be amenable to *scaling*, expanding first within Ahmedabad, but with a business model and technological base suited for future implementation in towns and cities elsewhere.

Although these latter frames—MYBYK as *bolt-on*, Janmarg as *protective space*—both followed MYBYK's value proposition as an innovative, low-carbon solution to the last-mile problem, tensions between the two proved difficult to reconcile, choking the service's growth. Those differences derived from the respective goals of their relevant social groups (Pinch and Bijker, 1984), and where and how those groups delineated the system from its operational environment. Politicians and AMC officials approached MYBYK as a complementary subsystem with enough proximity and integration to function as a 'mediating' device, but dependent on the BRTS's sustained operation for its user base. For those treating MYBYK as a bolt-on, hosting the service was a way to boost Janmarg's operational capabilities. Soni and his colleagues, conversely, treated the BRTS as a distinct infrastructural system, seizing on its relative obduracy and apparent momentum to frame Janmarg as part of their operating environment, beyond their control. (cf. Hommels, 2008;

Hughes, 1987: 55) From their perspective, their leverage of the BRTS infrastructure was a strategy to develop bicycle-sharing as a sociotechnical innovation, generating revenue, with the aim of expanding and integrating cycling into existing transportation systems. (Shaheen et al., 2010: 159)

Without the blockage caused by these conflicting framings, it would have been easy to envisage, instead, a continued superposition of Janmarg's bus stops and MYBYK's terminals.[109] In this scenario, we can see a productive role for obduracy and material resistance, with Janmarg's physical infrastructure providing a protective environment for MYBYK's founders to develop an innovative and sustainable bike-sharing service. Protection, however, can easily become protectionism, with shielding measures captured by actors uninterested in innovation or service quality. At the same time, business opportunities constructed through *jugaad* or bricolage can result in satisficing or stagnation, restricting growth. (Baker and Nelson, 2005) While the withdrawal of Modi's patronage impeded MYBYK's local expansion, and Soni's dreams of 'fourth-generation' bicycle-sharing would have required greater investment from the service's backers, Janmarg's material obduracy played a key role in ensuring the service's longevity. Its busways, bus stops, the reconfiguration of the city's streetscape, and resulting striation and channelling of Janmarg's passenger base created a local selection environment conducive to MYBYK's survival, even as it prevented the physical interventions that would have facilitated the service's further growth.

6.4.e. Discussion

In this section, I focused on two systems—Janmarg and MYBYK—that promised greater mobility and connection, working to integrate different areas in a dislocated city. Adopted as an alternative to light rail, Janmarg capitalised on Ahmedabad's existing ring-radial road structure, rescripting the streets with elevated bus stops and dedicated busways. An extensive reconfiguration of the city's streetscape saw many structures demolished or relocated, with those remaining requiring tweaks to the project masterplan. These examples demonstrate how obduracy springs from social, discursive, and technical forms of embeddedness, following an 'interwovenness of heterogeneous elements of various ages and scales' characteristic of the city's urban form. (Hommels, 2008: 179)

[109] Comparable to how, in much of Europe, early telephone wires used the same poles as telegraph cables following the railways, while urban electricity cables made use of municipal sewer networks. (Giikalp, 1992: 60)

The co-location of MYBYK terminals with Janmarg infrastructure provided a strategic site to investigate how obduracy and mutability are articulated at a systemic level, not just in individual structures and artifacts, but across large technical systems encompassing multiple components and subsystems. Attending to the interface of these two mobility systems, and three different technological frames engaged by different groups, I showed how conflicting frames can produce obduracy, particularly in situations where two or more groups are opposed but continue to interact. (Hommels, 2008: 176) In this case, MYBYK's team experienced 'closed-out' obduracy (Bijker, 2010), lacking the power to modify the functions of the Janmarg BRTS, and pressured to perform a mediating role, while remaining vulnerable to further reconfigurations.

6.5. Discussion: Mutable infrastructures?

This chapter shared three sets of encounters—with street lighting, water supply and storage systems, and city-scale mobility infrastructures—to explore crosscutting dynamics of sociotechnical persistence and material change. Mapping the variable obduracy and mutability of Ahmedabad's infrastructures and urban systems, I showed how constructivist accounts of stabilisation and technological closure struggle to accommodate the diverse materialities of the postcolonial city.

Beginning with my disconcerting encounter with a set of newly installed halogen streetlights, in the first part of this chapter, I explored some differences between modern and customary infrastructures. Casing these lights as a temporary, festive apparatus predicated on reconfigurable materiality, I initially assumed a correspondence between the lights' abrupt appearance and the apparent informality of the former walled city. Revealed as a formal intervention, in tension with the apparently 'backward' context of the *pols*, my disconcertment showed the influence of an orientalist frame, which emphasised and naturalised differences between a familiar urban European hinterland and my field site of Ahmedabad.

Addressing marginal or neglected examples of water supply and storage, in the second section, I extended my analysis to a historic stepwell, the use of rooftop water storage tanks (*tankis*), and the reclamation and repurposing of a cistern (*tanka*) once used to store rainwater. In each of these three examples, relations of mutability and obduracy tracked the workings and gradations of power. Although obduracy has primarily been

used to explain how and why large, complex structures and systems resist reconfiguration, asymmetries of power mean obduracy is experienced more or less acutely by differently positioned actors. In the case of the stepwell, different rulers' varying capacity to marshal materials and resources affected the well's construction and use. The widespread use of rooftop water storage tanks demonstrate the role of user agency, as individual households overcome the limitations of a system over which they exert little influence. Rainwater cisterns and *tankas* once enabled wealthy households to provide their own water during Gujarat's harsh summer months, but the separation of material infrastructure and social practices has impeded their restoration and return to use.

The third and final section focused on the interface of two distinct mobility systems: Ahmedabad's Janmarg BRTS, and MYBYK, a bicycle-sharing service. Examining these two services' distinctive logics and the different frames held by relevant groups, I showed how obduracy, mutability, and material resistance shaped their respective trajectories—enabling the rapid and successful implementation of Janmarg, while limiting the scaling of MYBYK's for-profit business model.

The material properties of given systems, infrastructures, and technologies are, ultimately, inadequate to explain their variable obduracy or mutability. In addition to the durability of sandstone or the black-boxing of municipal infrastructure, a given system's receptivity or resistance to change can turn on details of social reproduction, religious significance, political patronage, user practices, and hierarchies of value. In the words of Anique Hommels, urban systems are embedded in broader networks of 'rules, plans, policies, standards, institutions and norms' (Hommels, 2008: 184). New urban structures become progressively more integrated into the existing urban fabric, adding to their obduracy and resistance to change. Values and sustained meanings become part of this hardness, mediating between different groups of actors as they seek to negotiate material configurations. (ibid: 184-186)

With the cases introduced in this chapter mapping different manifestations of mutability, I have aimed to include settings where infrastructures exhibit varying degrees of reconfigurability, as mediated by different forces, practices, and structures, at different moments in time. In the next chapter, I turn to *mobility*, examining more closely the extent to which given infrastructures and urban technologies circulate between sites, and how much they are able—as in those earlier discussions of the immutable mobile—to hold their shape while doing so.

Chapter 7: Mobile infrastructures

7.1. Introduction

Inspired by the new mobilities paradigm (Sheller and Urry, 2006; Urry, 2007), and recent work on policy mobilities[110] (Peck and Theodore, 2015), this chapter looks how technology and infrastructure move between locations. Sharing two cases where the arrival of foreign technology in India was met with anxiety and enthusiasm, I argue that the strength of these responses reveals the often underappreciated role of cultural difference in sociotechnical change. (cf. Jamison and Hård, 2003)

The first case unpicks the connotations of a social media post, whose author assumed the persona of a former cabinet minister to satirise the instabilities of discourses of development and Hindu nationalism. In the depicted scenario, strong, top-down executive power, used in the single-minded pursuit of development and modernisation, results in the like-for-like reproduction of 'quality' infrastructure from overseas. Comparing this social media post with the work of Indian newspaper cartoonist R.K. Laxman (1921–2015), I track the changing causes of failure for Indian infrastructure development. Where infrastructure projects in India once failed by moving too slowly, falling victim to market downturns or changing policy priorities, contemporary political actors risk moving too quickly, while failing to consider local users' needs.

In the second case, the arrival of solar-powered plane *Solar Impulse 2* provides a strategic site to probe technology's more-than-functional effects. An experimental prototype and demonstration project, Solar Impulse was built not to carry passengers, but to promote a vision of technology-led sustainability. I contrast the aircraft's time in Ahmedabad with its presence at the COP21 climate conference in Paris to show how the mission promoted a market-based, technology-led voice on climate issues, even as it failed to engage with local politics and the diverse applications of solar energy. Solar Impulse's message is implicated in dynamics of race and racialisation, with the whiteness of the aircraft and its team bolstering the mission's projection of innovation, adventure, and technical expertise.[111] Contrasting the mission's universalising message with its treatment of cultural difference, I show how the differential mobilities of the aircraft and its local audiences reaffirmed a racialised hierarchy of value.

[110] For a short overview of the referenced policy mobilities literature, see Chapter 3; pp. 49–51.
[111] See interlude on 'Assembling whiteness'; pp. 112–114.

7.2. Roads, smart and new

In this first section, I analyse a viral Facebook post purporting to depict a road newly installed in the city of Varanasi, with Japanese support. Engaging registers of parody, satire, and critique, the image commented on the realities of infrastructure-led development in India. Playing on unease around the rapid implementation of infrastructure models originating outside India, the post used humour to scrutinise the Indian government's approach to technology mobilities and infrastructure-led development, and the problems and hypocrisies concealed in dominant political discourse. To ground and develop my analysis, I also introduce a real case of a Japanese-designed 'smart road' installed in Ahmedabad, as part of the high-profile Sabarmati riverfront development.[112]

7.2.a. New roads in Varanasi

As I come to the end of my time in Ahmedabad, an image appears on my Facebook feed, shared by a researcher in the planning department of one of the city's many universities.[113] My energy levels are low. Approaching the end of my research, and having left it too late to pursue any further lines of inquiry, I fall back into an anxious browsing of local news media, scrolling through social media feeds in anticipation of my looming return to the UK.

As part of this ever-replenishing wellspring of reports, news articles, and YouTube videos, this post seems somehow dissonant. The image appears to show a new road built in the city of Varanasi, in Uttar Pradesh, by a team of Japanese engineers. The road markings, however, are in Japanese: white kanji painted on the tarmac. Naming and describing the project—'new roads in Varanasi'—a text caption thanks Modi and Kyoto for the project, before imploring the reader to share the post: 'Media will never show. Share this till it reaches every Indian.' (Figure 4)

This road image is one of many posts made by an 'unofficial' Facebook account registered in the name of Subramanian Swamy, a former cabinet minister and BJP ally in the Rajya Sabha, India's upper house. Run by an 'average, middle-class Indian'[114], the

[112] For more details, and a discussion of the Sabarmati project, see Chapter 8; pp. 205–210.
[113] From field notes, 4 April 2016.
[114] From Tripathi (2016).

account has over half a million followers. Parodying the actual figure's reputation and extensive use of social media, the account posts memes and pictures that satirise Swamy, the BJP, and their Hindutva ideology.[115] This has caused confusion on social media, with many of Swamy's followers reportedly mistaking the spoof for reality. [116]

Responses to this post are split between those in on the joke and taking the image at face value, and between critics and supporters of Modi's NDA government. Some commenters express their scepticism or incredulity, pointing to the Hello Kitty cartoon characters adorning the railings, and attacking the image as 'fake news': 'There is no such road in Varanasi.' Others reference Modi's campaign promises of 'good times'[117], with varying levels of irony, and the much-vaunted 'Make in India' initiative, as well as users' experiences of rising petrol prices, and the various perceived failings of the 'Gujarat model' of development: 'And just in case if someone is wondering that *Bhagats* [devotees] won't fall for this, just wait & watch ... You won't be disappointed.' 'Their entire life will go in imagining the fake illusions of development.'

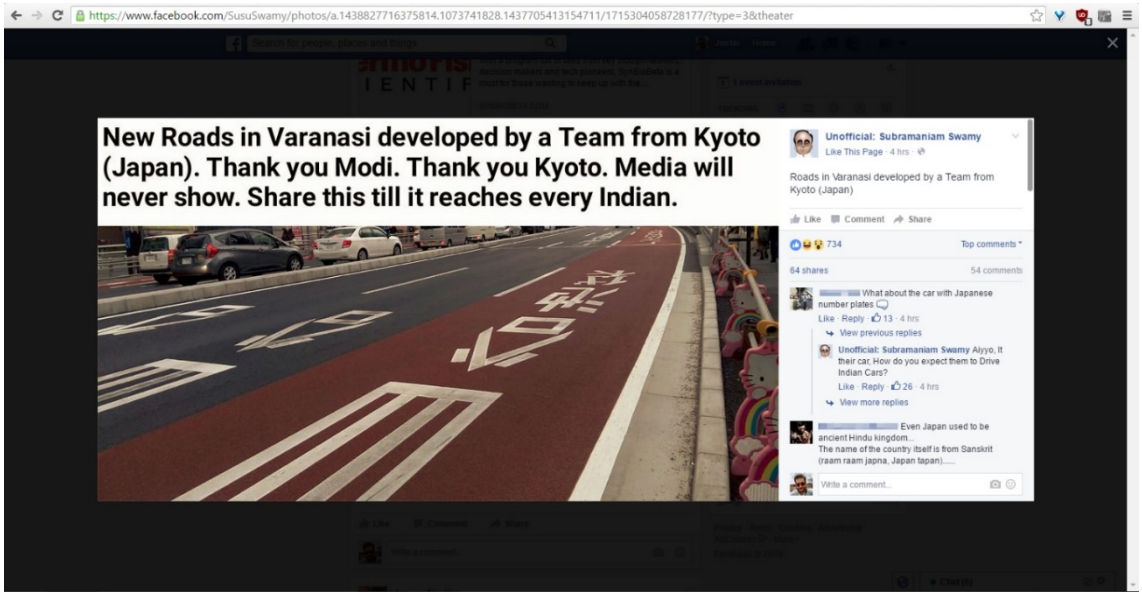

Figure 4. 'New Roads in Varansi', 4 April 2016 (Unofficial: Subramanian Swamy)

[115] From The News Minute Staff (2016).
[116] From The News Minute Staff (2015; 2016).
[117] See Kaur (2005).

Taking road infrastructure as its subject, this post used a complex form of humour to parody and critique government priorities. Its framing and content combined a close mimicry of the persona of politician Subramanian Swamy, the authoritative discourse of the ruling party, and rhetorics of development and economic growth. The image claims to depict a failed example of urban sociotechnical change. The Indian state's hunger for development, it seems, have resulted an in entirely new road, installed with little consideration of the particularities of language—and, by proxy, the intangibles of culture, society, and the road's local context of use.

'Thank you Modi. Thank you Kyoto. Media will never show. Share this till it reaches every Indian.' Mimicking a specific form of discourse, the creator's choice of caption parallels 'stiob', a kind of parody common under late socialism in the USSR. (Yurchak, 2006) Mimicry played straight, stiob was enabled by the emergence of an over-formalised authoritative discourse comprising predictable, repeatable forms of phraseology, structure, and style. (Boyer and Yurchak, 2010: 191) Practitioners of stiob believed overidentification with a given discourse sent a 'more potent critical signal … than any revelatory expose or gesture of ironic diminishment' (ibid: 182). By adopting the persona of Subramanian Swamy, a 'maverick politician' known for his 'caustic style' (Udupa, 2017: 1511), the account operator followed a similar strategy, never breaking character, and overidentifying with a dominant Hindu nationalist discourse addressing an identified audience of *bhakts*, or devotees.

7.2.b. 'Thank you Modi. Thank you Kyoto.'

Identifying the road as the work of a team from Kyoto, the post's caption nonetheless expresses gratitude to Narendra Modi, who is portrayed as responsible for its installation in Varanasi. This framing recognises Modi's central role in Hindutva discourse, as the 'prime agency' promising future 'good times' to the Indian people. (Kaur, 2015: 324) Having campaigned on the promise of streamlined decision-making and greater freedom for the private sector, the NDA government has concentrated and personalised authority, imposing greater discipline over civil servants, while combatting the clientelism and corruption that dogged previous administrations. This centralisation of authority has come at the expense of cabinet government and collective decision-making, with the use of 'special prerogatives', such as national policy 'Missions', expediting Modi's exercise of executive power. (Ruparelia, 2015: 757-758)

In the aftermath of the 2002 Gujarat pogrom[118], Modi was barred from entering the United States and the EU—a decade-long informal boycott that saw him instead look eastward in pursuit of his goals. (cf. Colvin, 2013) As Chief Minister of Gujarat, he made highly publicised visits to Japan, China, and South Korea. (Michael, 2018: 66) Visiting Japan, Modi cultivated a close personal rapport with then Prime Minister Shinzo Abe, something he built on in 2014, when India and Japan announced a 'special global strategic partnership', comprising economic and military cooperation, $35bn in Japanese investments, and support for India's plans to develop high-speed rail. (Michael, 2018: 72) As part of this partnership, the cities of Kyoto and Varanasi signed a memorandum of understanding, with the former supporting Modi's plans to retrofit Varanasi as a 'smart city', lending expertise and cooperating on heritage conservation and urban development. (Press Trust of India, 2014)

During my time in Ahmedabad, the Indian press regularly reported on Japan's involvement in Indian infrastructure projects, including a high-speed railway connection using Japan's iconic *Shinkansen* bullet train rolling stock to link Ahmedabad with Mumbai.[119] With transport and mobility projects accounting for 60% of Japan's development spending in India (Jain, 2018: 249), one of the most recognisable Japanese-supported projects was the Delhi Metro, inaugurated in December 2002, and promoted as a symbol and catalyst for the city's modernisation. (Sadana, 2022) The project was planned as a technology exchange, with companies from Japan, Korea, France, and the United States transferring their expertise to Indian firms, who were expected to take a more prominent role in the system's future expansion. (Siemiatycki, 2006: 280) Today, Japan has since provided loans and technical support for similar metro and light rail schemes across India, with demand for such projects expected to grow as urbanisation continues.

For the Japanese government, investment in Indian infrastructure has boosted Japan's power to 'guide the development of ... connectivity in the Asian region' (Jain, 2019: 3), providing an alternative to China's infrastructure-led Belt and Road Initiative. (Rolland, 2017: 127) One of the projects supported by this investment, support for a Mumbai-Ahmedabad high-speed rail connection illustrates a culturally and geopolitically specific, 'Japanese' approach to overseas development, stressing the value of self-help, and marked by a preference for yen loans over grant-based aid. (Kato, 2016: 7) Japanese development

[118] See Chapter 4; pp. 57–58.
[119] Representing Japan's largest even single-country development assistance loan. (Jain, 2018: 11)

efforts have favoured projects contributing to the receiving state's knowledge base, skills, and human resources (ibid: 8-9, 11), seeking to cultivate a sense of partnership rather than passive receivership. (Jain, 2019: 11)

Facing an ageing workforce, and with 'offshoring' leaving Japanese exports less economically competitive, the transfer of infrastructural systems has been a promising economic strategy for Japan; capitalising on firms' tacit knowledge and Japanese development institutions' emphasis on locally situated solutions. (Yoshimatsu, 2017: 503-504) Sharing findings from her research on development pedagogy in Japan and Myanmar, anthropologist Chika Watanabe qualifies the significance of 'self-help' and human development in Japanese overseas aid. Highlighting the role of *hitozukuri* ('making persons') as an pillar of Japanese development policy, Watanabe describes how aid actors work to 'become and adapt 'good' models of change' (Watanabe, 2017: 596). A 'Japanese' approach to development assistance, therefore, often relies on field demonstration projects, as generative sites for mimicry, imitation, and social learning. For Watanabe's research subjects, the stability or precise replication of a given model proved less important than how these models changed to meet their contexts and environments, negotiating tensions around similarity and difference. (ibid.)

For the Mumbai-Ahmedabad bullet train, India accepted tied loans, with terms mandating their spending on Japanese hardware and expertise. (Jain, 2021: 250) Japanese development institutions justified the loans by stressing the value of 'quality,' sustainable infrastructure, backed by proven technology, design, and construction. (Jain, 2019; 2021) Seeking points of differentiation from China's Belt and Road Initiative, this Japanese development imaginary played on cases where 'cheap, but shoddy' Chinese-backed projects foundered, having been put together too quickly, delayed by ineffective project management, or else saddled recipients with onerous interest repayments. (Yoshimatsu, 2017: 507) Effectively accusing China of hewing too closely to linear, diffusionist models of innovation and technology transfer, Japanese invocations of 'quality' endorsed a translation-based frame for infrastructure exports. In this understanding, infrastructure differed from other technologies in its systemic character and close coupling with its operating environment and contexts of use. (Garb and Friedlander, 2014: 16) Requiring active tailoring to accommodate social, cultural, and biophysical difference, any useful development assistance would treat infrastructure not as an inviolable formula, but a model or template amenable to reconfiguration. By counterposing 'shoddy' and 'quality'

projects, Japanese aid actors portrayed their own interventions as relatively high value, contributing more effectively to recipient countries' development goals.

Though references to Varanasi and Kyoto played on an existing 'smart city' partnership, by expressing gratitude to Modi and a Japanese development team, this piece of viral media critiques Japanese involvement in 'quality' infrastructure and urban development in India. Parodying prominent development imaginaries, much of the post's humour derives from its audience's awareness that these 'new roads' are more modern and technologically advanced than any home-grown Indian solutions. The post also expresses, however, an ambivalence about what the adoption of 'quality' infrastructure might entail. In the scenario depicted, Modi's executive power and Japan's strategic and economic interests coproduce a road in tension with its operating environment and, by extension, the needs of its users—a failure rendered absurdly visible, in this image, by the retained kanji road markings.

7.2.c. 'Media will never show. Share this till it reaches every Indian.'

The second part of the Facebook post's caption, this call to action reflects a sense of grievance on the part of Swamy and other Hindu nationalist figures, denigrating a mass media dominated by 'secular liberalism' as biased and anti-national, out of step with India's Hindu majority. (Udupa, 2017: 1511) Modi and the BJP were cast as 'outsiders', their achievements systematically underreported by a metropolitan media sympathetic to the values of the centre-left Congress opposition. Following the 2014 election, accusations of mis- and non-representation have served to legitimate curbs on media freedom, and the replacement of institutional leaders with more establishment-friendly figures. (Kaul, 2017: 529) Against this backdrop, the 'unofficial' Swamy account's call to 'share' his post mimics a heavily mediated form form of 'enterprise Hindutva', leveraging the affordances of social media. (Udupa, 2018: 453) Propelled by technologically literate volunteers, motivated by the prospect of triumphing over their ideological rivals, this enterprise Hindutva sees participants actively 'commenting, tagging, tweeting, retweeting and posting', and in doing so, reproducing Hindu nationalist ideology as a dominant discourse. (ibid: 356)

In their work on stiob, anthropologists Dominic Boyer and Alexei Yurchak compare late Soviet parody with 'similar aesthetics and sentiments' emerging in the United States.

(Boyer and Yurchak, 2010: 180-181) Arguing that 'late liberalism' operates under ideological and discursive conditions much like those of late socialism, they suggest stiob-like practices rely on 'highly monopolized and normalized' conditions of cultural production. (ibid: 181) Similar conditions are also present in Modi's India. In the 2014 election campaign and its aftermath, the BJP and its allies unleashed a volley of slogans, e.g. *Acche Din* ('good times), 'Gujarat model'*, Vikas Purush* ('development man'), *Sabkha Saath, Sabkha Vikaas* ('taking everyone along, development for all'). (Kaur, 2015; Hill, 2016; Udupa, 2017) Promoted and reproduced by *bhakt* 'voluntary entrepreneurs' (Udupa, 2018), these discourses fortified a 'postreform consensus' blending economic liberalisation and majoritarian cultural nationalism. (Kaur, 2015) For ordinary Indians, this messaging is omnipresent, with the BJP's narrative of Hindutva and development continually reinforced across every medium. (Kaul, 2017: 532) As a result, dynamics of hypernormalisation see political language emptied of meaning, leaving formal discourse 'saturated with overcrafted, repetitive and frequently esoteric formulations' far from its intended audience's lived experience.[120] (Boyer and Yurchak, 2010: 182)

The narrowing and semantic emptying of discourse in contemporary America and the 'late socialist' USSR occurred in contexts of media consolidation, a product of the resulting absence of public debate, and meaningful opposition to state messaging. (Boyer and Yurchak, 2010) Although Modi's India shares many of these features, the embedding and proliferation of Hindutva discourse has taken an explicitly oppositional stance, engaging rhetorics of antagonism, abjection, and othering. Hindu nationalist politicians and their followers have established a narrative of thwarted development, undermined by a secular 'liberal' elite in thrall to an 'anti-national' Muslim minority. To parody this discourse, the 'unofficial' Subramanian Swamy account could not rely solely on the affordances of broadcast media, as in Soviet or American stiob. (cf. Yurchak, 2006; Boyer and Yurchak, 2010) Instead, it had to show continuity with the dialogic, argumentative modes of 'enterprise Hindutva' found on social media (Udupa, 2018), addressing and enlisting an imagined audience of supportive participant-volunteers.

[120] To share one concrete example, I think back to a recreational day trip to the Polo Forest, in the foothills of the Aravalli mountain range, in April 2016. Gathering for a group photo at the end of our hike, sweaty and tired, someone hoots "Make in India!" as the shot is taken—a reference to a then current government program of the same name, an investment-led attempt to transform India into a design and manufacturing hub. The laughter of the other hikers reflected both a familiarity with the slogan, widely and solemnly reproduced in the news media and government communications, and their amusement in seeing an already overstretched phrase decontextualized further; deployed in a situation where its semantic meaning was not merely tenuous, but immaterial.

In this case, even a relatively short caption proved capable of registering the roles of Modi and Japanese development assistance, the centralisation of authority in India's NDA government, specific instances of Japanese-Indian cooperation, the BJP's reliance on volunteers, and their vilification of a liberal urban elite. On a surface level, the post worked as parody; a sufficiently close mimicry of semantically emptied discourse to confuse many of those leaving comments in response. However, an analysis of the post as a media text shows how the stiob comparison flattens its cultural specificity, missing some of its supplementary effects. Building on a stiob-like textual mimicry, the juxtaposition of caption and image produces an absurdist caricature, spotlighting the contradictions and incongruities in these discourses of infrastructure-led development. In addition, a closer scrutiny of the post's purported content, and its implications, shows how the parody also operates as a trenchant political critique.

7.2.d. Caricaturing infrastructure-led development

To appreciate how this Facebook post moved beyond parody to critique infrastructure-led development, it is necessary to address its cultural context. Having demonstrated how the 'New Roads' post overidentified with Hindutva rhetoric, to comedic effect, in this section, I consider the role newspaper and so-called 'pocket' cartoons have played in Indian politics and society—with particular reference to the work of *Times of India* newspaper cartoonist R. K. Laxman, and his depictions of infrastructure projects and development.

In her 2014 monograph, *Caricaturing Culture in India*, anthropologist Ritu Gairola Khanduri describes how Indian cartoons have been unmasking the hypocrisies and duplicity of empire since the 1850s. (Khanduri, 2014: 2) A popular cultural form addressing a general readership, newspaper cartoons offered a creative epistemic response to the ruptures of Indian independence and the resulting sociopolitical transformations. The form became a way for estranged Indian subjects to make modernity 'comfortable' for themselves (Chakrabarty, 1999: 109), providing 'critical modes of public communication and politics ... [in] questioning India's developmental agenda, democratic governance, and secular credentials.' (Khanduri, 2014: 2) In a country with established habits and practices of newspaper-'taking' (cf. Peterson, 2010), political and pocket cartoons have had an enduring influence, and remain an important part of Indian cultural life.

My initial weeks in Ahmedabad, in January 2015, coincided with the death of Indian cartoonist R.K. Laxman, aged 93. Laxman's drawings had tracked the history of independent India, appearing on the front page of *The Times of India* since 1951. Extensive coverage of Laxman's life, tributes, and reproductions of his drawings provided a trenchant introduction to India's national politics and modern history.[121] On the front page of the *Times of India*, one of Laxman's single-frame 'pocket' cartoons depicted a pair of politicians returning to their chauffeur-driven car, having met with a group of villagers: 'I was afraid they would demand drinking water, schools, etc. Luckily they only want a separate state.'[122] Depicting a scenario in which identity politics and communitarian divisions were a more expedient source of political support than the sustained, long-term policies required to deliver development, this cartoon showed a 'democracy laughing at itself for the aberrations from its idyllic potential' (Chatterjee, 2007: 303). Development, in Laxman's work, was to be a 'never-ending project' (Khanduri, 2012: 306), endlessly deferred or frustrated by the structural limitations and capture of India's electoral process.

Later, while taking Hindi language tuition in a warren of rooms attached to a former American Presbyterian church in the Himalayan foothills, I pick up four well-thumbed paperback collections of Laxman's work from a local bookseller. Published by Penguin Books India in the 1990s, after an initial compendium of Laxman's pocket cartoons had become an instant bestseller, these books were but a few of the 15 volumes released to meet public demand. Flicking through the collections, recurring subjects include election campaigning, road repairs, slum clearances, strikes, film stars turned politicians, party fissures and defections, under-attended political speeches, airplane diplomacy, beggars, bribery, astrologers, post-disaster aid, and the frequent failings of India's telephone network. In these cartoons, infrastructure typically appears in the idiom of the 'project'. Massive signs for new dams or power projects signal the significance of disturbed earth, barrels, abandoned pickaxes, and lengths of pipe. (Laxman, 1993; 1994; 1998; 1999)

In Laxman's cartoons, projects are delayed as costs spiral, and ceremonial foundation stones once laid by visiting ministers fall into disrepair. (Laxman, 1999: 165) Abandoned construction sites are mistaken for blast damage or the consequence of foreign economic sanctions. (Laxman, 1994: 41; 1998: 200) In one cartoon, road works are seen to have continued for long enough to risk being declared a 'heritage item', and thus

[121] From field notes, 28 January 2015.
[122] From photo, 28 January 2015.

protected from further modification, a play on stringent regulations protecting India's archaeological monuments.[123] In another, a completed railway station stands among village huts, with no connecting railway lines. 'No trains,' says a villager with a goat, 'just a station to make the place look a little progressive. The new minister is from here, you see!' (Laxman, 1999: 65) In each of these cases, Laxman depicts such projects as stuck, languishing in the limbo between approval and construction, subject to the vagaries of government funding, or else contingent on economic growth. (Laxman, 1994: 160)

Laxman's cartoons were elevated from parody to critique by his inclusion of a drawn character representing India's 'Common Man'. Balding, with spectacles perched atop a bulbous nose, the nameless Common Man is a reader surrogate, scapegoat, and everyman.[124] Intended as a proxy for the ordinary Indian, his silent presence allowed Laxman to mediate a 'national response' to Indian politics (Khanduri, 2012: 309), allowing readers to laugh at their predicament as citizens of a failing democracy. (Sanyal, 2015) Traversing the ordinary spaces of homes, government offices, airport departure halls, scientific laboratories, and rural villages, the Common Man witnesses the 'daily breakdown of the nation' with a furrowed brow, as 'interchangeable politicians and their retinues of development specialists come and go.' (Sanyal, 2015) As Shiv Visvanathan wrote in his obituary for Laxman in *The Indian Express*, the Common Man 'conveyed the artlessness and helpless of citizenship, of watching the world loyally like a spectator, even if half its moves puzzled you.' (Visvanathan, 2015) Like the 'New Roads' post, Laxman's pocket cartoons reproduced dominant political discourses as a way of revealing their limits. The Common Man shone a spotlight on the gap between national politics and the needs of the people, providing readers with a space to question the logic of India's political model and social agenda. (Khanduri, 2014: 165)

Comparing Laxman's pocket cartoons with the 'unofficial' Subramanian Swamy Facebook post, differences between the two texts track their distinct media environments. Where Laxman and his publishers could assume a relatively stable, predictable newspaper-taking audience, the possibility of 'infinite digital replication' through social media has created a subversive 'structure of participation ... with a suasive force of its own.' (Kumar, 2015: 232-233) In assuming the persona of an existing political figure with

[123] See Chapter 6; pp. 126–127.

[124] Replacing earlier cartoon representations of the Indian nation as Bengal tiger or *Bharat Mata*, a semi-divine mother figure in a crown and carefully-draped sari, the character freed Laxman from having to portray the diversity of India's 'teeming millions', or overburdening existing figurations of 'gods, demons or folk tales to represent [current] political events' (Laxman, 1993: i).

known behaviours and sympathies, the creator behind the 'unofficial' Subramanian Swamy posts worked to unsettle the relationship between form and content, dismantling a prevalent mode of Hindutva discourse from within. (ibid.) As new media platforms have allowed content to spread, finding new meanings among new, secondary audiences, the combination of subverted meanings and rapid diffusion has created a 'new grammar of critique' far beyond 'rational critical debate' (ibid.). Laxman's Common Man, a silent witness, has been supplanted by the *bhakt* participant-volunteer.

In mimicking dominant discourse, the Facebook post makes a normative claim about the role of infrastructure in national development. At play, here, is not just the hypernormalisation of the NDA government's emptied rhetoric, but the strategic incoherence of its claims, with systemic inconsistencies in messaging used to appeal to different bases and interest groups. Juxtaposing a celebratory caption with the image of a failed road construction project, this post plays with instabilities in government discourse. The idea of Japanese-developed roads being hailed as a triumph for Modi—and India—exposes the absurdities of a government seeking to juggle economic internationalism and cultural-religious chauvinism while courting foreign capital; side-lining early nationalist ideals of autonomy and self-governance, and seeking to restore the status of a 'new' India by importing 'quality' infrastructure and superior technical solutions from overseas.

At a second level, the post critiques Modi's reliance on executive fiat to fast-track strategic infrastructure projects, bypassing regulatory obstacles and overcoming material obduracy. In his supporters' eyes, this was a clear advantage, with strong governance embodied in a leader able move swiftly and decisively, enacting a plan, whatever the consequences. (Kaul, 2017: 536) Claiming to depict a transplantation of 'quality' Japanese infrastructure from Kyoto to Varanasi, the implication is that the transfer was undertaken with great urgency, but insufficient deliberation, such that the road markings remained untranslated; revealing the emptiness of the caption writer's designation of the project as a success.

Where the 'projects' satirised by Laxman failed by moving too slowly, the 'New Roads' post instead depicts the hazards of strong, top-down decision-making. With the NDA government deriving its legitimacy from a populist, majoritarian claim to represent the nation, and willing to push through development projects unencumbered by planning, regulations, or legislative constraints, the depicted failure is a failure of *translation*. The impression given by this pairing of caption and image is of the Indian government treating

these Japanese-developed roads as an immutable mobile, easily delaminated from their original sociocultural and physical context, rather than something stickier, more contingent on their surroundings. (cf. Scott-Smith, 2018) What might Laxman's Common Man have made of this? Confronted with this apparent mistranslation, and a caption marking the Hindutva *bhakts*' eager framing of such as a triumph of development, those reading and sharing the post are cast in a comparable role; silently witnessing the gap between the administration's lofty promises and material reality.

7.2.e. Smart road in Ahmedabad

Though the 'Japanese' road in the Facebook post was a parody, a self-described 'smart road' project was, in fact, implemented in Ahmedabad with Japanese funding and support. Installed by the Indian subsidiary of a Japanese company promising 'intelligent transport and traffic systems ... customized for the Indian subcontinent'[125], this initiative saw digital sign boards installed along a length of Ahmedabad's Ashram Road, using traffic cameras and GPS information from vehicles to optimise traffic and road occupancy. This project built on a $1m pilot funded by Japanese development agency JICA, which supported the installation and operation of four such signs on a 10km stretch of ring road between October 2014 and March 2015, as part of a technology demonstration scheme for SMEs. After the demonstration, the project was handed over to the AMC, who reappointed the same firm to manage the system's ongoing maintenance and operation. In September 2017, this project was expanded to cover the entirety of the city's Ashram and Riverfront Roads, integrated into plans to redevelop the Sabarmati riverfront.[126]

In videos and promotional materials (Figure 5), the right half of the sign board was shown offering traffic information, overlaying recommended alternative routes on maps of local road layouts, alongside information about incidents, roadworks, or congestion . The left half cycled through sponsor and public information messages, warning drivers against using their mobile phones, and reminding those on two-wheelers to wear helmets. Also used to show the weather forecast, or an image of Narendra Modi welcoming people to Gujarat part of an India-Japan Annual Summit, these digital signs have been promoted as a platform for advertising, with clients including Panasonic, Hyundai, Gujarat Tourism, Tata, Maruti Suzuki, and local radio stations. Although advertising revenue was intended to

[125] From company website.
[126] For more details on the reconfiguration and commoditisation of the Sabarmati riverfront, see Chapter 8; pp. 205–210, 214–217.

cover the system's operation and maintenance costs (Banerjee, 2014), the firm's managing director described the problems in implementing this funding model, as Ahmedabad's incumbent media firms petitioned the AMC to assert their exclusive rights to outdoor advertising where the sign boards were to be installed, requiring an intervention by the commissioner. (Anand, 2017a: 29)

Figure 5. Zero Sum Ltd. signboard on Riverfront Road, Ahmedabad (YouTube)

Where the 'New Roads' post posited a lateral transfer of infrastructure, this short example of 'smart road' technology shows the crucial role of adaptive translation, with the firm explicitly addressing the distinctiveness of the 'Indian subcontinent'. In contrast to the untranslated kanji of those ostensible roads in Varanasi, which stood as a mark of failure, decisions over the best way to communicate traffic information to Ahmedabad's road-users proved 'mind-boggling', with Japanese project managers on record as struggling to choose between difference combinations of text, maps, and images, and in what languages. (ibid.)

7.2.f. Discussion

In this section, the case of a satirical Facebook post provided an opportunity to reflect on the politics of infrastructure mobilities in Narendra Modi's India. Undertaking a close analysis of this media text as part of my engagement with Indian infrastructure, I looked at how the post's comic sensibilities addressed a fragmented public (Khanduri, 2014: 296), using parody to highlight and critique top-down decision-making by executive fiat. Appraising the text's humour and framing of infrastructure-led development in relation to its cultural and historic context, I explored how this pairing of caption and image tracked government supporters' perceptions of Modi as a decisive strongman; his role in strengthening ties with Shinzo Abe's Japan; Japanese development assistance to India; the Indian government's wall-to-wall sloganeering and promotion of government initiatives; Hindu nationalists' oppositional rhetoric of grievance; and the promotion and propagation of Hindutva discourse by online volunteers.

As caricature and critique, the humour of the 'new roads' post derived from the sharp incongruity between Modi supporters' overblown rhetoric and a 'Japanese' road construction project that would have failed by its own criteria, offering few opportunities for human development or social learning. (Watanabe, 2017) Comparing this with the work of *Times* cartoonist R.K. Laxman, to elucidate how caricature might critique development, I showed how differences between the two texts reflect shifts in India's media environment, in government rhetoric, and in the role of infrastructure in international development. With Modi as the *Vikas Purush* ('development man'), using assertive leadership to push for economic growth and development for all (Smith, 2017: 324), foreign loans for spectacular, modern transport projects, such as high speed rail, have replaced the dams, steel plants, and power stations constructed by Nehru and his Congress successors.

Comparing the supposed 'New Roads' of Varanasi with Ahmedabad's actual 'smart road' initiative illustrates the difference between point-to-point technology 'transfer' and a more sustained act of translation. In the Facebook post, the road transferred from Kyoto to Varanasi was treated by the authorities as highly autonomous, and easily decoupled from its original context, with predictably deleterious results. By contrast, the Japanese firm seeking to transfer their 'intelligent traffic system' to Ahmedabad saw the importance of tailoring their existing template, such that it could better meet the needs of its Indian users.

7.3. Solar Impulse 2

Having looked at anxieties around the transfer of infrastructure between contexts, in this section, my encounters with *Solar Impulse 2*, an experimental solar-powered aircraft, provide an opportunity to examine the symbolism and poetics of technology, and their implications for its mobilities. In this case, the promise of witnessing a demonstration of innovation and engineering prowess was sufficient motivation for an estimated 15,000 visitors to queue for hours in the heat of the day, while braving the risk of exposure to a local outbreak of the H1N1 swine flu virus. I argue that the aircraft's enthusiastic reception in Ahmedabad shows how new technologies are implicated in relations of desire and fantasy, assuming 'fetish-like aspects' detached from—or exceeding—their technical functionality and intended purpose. (Larkin, 2013: 329)

7.3.a. Prototype as message

I am one in a trickle of people, picking our way past warehouses and across car parks, out, to the perimeter of Ahmedabad's international airport.[127] Ducking under a fence, we re-join the airport's main access road, then double back, into a sun-bleached field. The crowds grow larger. As we pass an electrical substation, two charter coaches turn into the field. I turn to watch as the vehicles pull up, each disgorging a crowd of uniformed school children and their teachers.[128] The crowd is pulled into a line, a queue. I fall into conversation with an assistant pharmacist in his late teens, and his uncle, a pathologist at the city's Civil Hospital. They, like the rest us, are here to see the aircraft: *Solar Impulse 2*, a one-seat, Swiss-made, electric monoplane, its single, 70ft-long wing clad in a thin layer of grey-blue photovoltaic cells. The plane, its two pilots, and ground crew are in Ahmedabad as a stopover on their planned circumnavigation the globe, the first such attempt by a solar-powered aircraft; a series of hops taking them from their departure point in Abu Dhabi, via Oman, and on to Myanmar, Japan, and—after overwintering in Hawaii's Kalaeloa Airport, stranded by an overheating battery[129]—California, New York, and Cairo.

The Solar Impulse mission is a privately financed undertaking, founded by two Swiss men; engineer and entrepreneur André Borschberg and psychiatrist Bertrand Piccard. The

[127] From field notes and photographs, 13 March 2015.
[128] From photo, 13 March 2015.
[129] From Griggs (2015).

son and grandson of explorers, Piccard is best known for being one of two men to undertake the first non-stop circumnavigation of the globe, in the *Breitling Orbiter 3* balloon. With Solar Impulse, he hoped to leverage this reputation, invoking a 'family legacy of scientific adventure'[130] to build support for the project—its proposed round-the-world flight promoting renewable energy and clean technologies. An initial prototype, *Solar Impulse 1*, was able to fly for up to 36 hours. After test flights in 2009, this first aircraft flew again in 2010, 2012, and 2013, setting records and attracting public attention. Completed in 2014, *Solar Impulse 2* built on these successes, boasting the improved technical capabilities needed to fly for longer—and further.

I was first alerted to *Solar Impulse 2*'s presence in Ahmedabad by the local press. Enthusiastic coverage of the aircraft's arrival pushed news of a slow-burning H1N1 swine flu outbreak off the newspaper front pages. In the *Times of India*, a quarter-page advert from the Gujarat state government welcoming *Solar Impulse* to India ran alongside health guidance for students taking exams during the outbreak (Figure 6). On the Thursday, local newspapers and the Solar Impulse team's social media announced a 'public day' running from 7.30am the following morning, with the vehicle's hangar at Ahmedabad airport opened to visitors. Fearing contagion from H1N1, a month earlier, the city's district collector had imposed Section 144, a piece of colonial-era legislation barring public events and mass gatherings without prior permission.[131] By the time of the aircraft's arrival, public concern had waned, with health concerns doing little to deter enthusiastic visitors. At the airport, mandated information boards listed English language 'pointers', urging readers to 'stay home', 'avoid crowds', and 'SPREAD THE MESSAGE NOT THE VIRUS.'[132]

As the sun climbs higher and the queue sluices forward, I lose my new companions, vanished into the throng. A journalist and her cameraman stand off to one side, recording footage. A tattooed security guard blows his whistle at a man trying to smuggle his child under the barrier. Eventually, I reach the front of the queue. Ushered past billboards conveying the well-wishes of local politicians, I pass through a metal detector, whose insistent beeps go ignored. A class of school children line up against a hoarding, stretching and chattering excitedly. Entering the marquee, the air is noticeably cooler. The plane is larger than I had imagined. A twenty-foot length of the tent is fenced off for the public,

[130] From Solar Impulse website, <solarimpulse.com/vision>
[131] Where events could not be cancelled or postponed, organisers had to ensure adequate countermeasures, providing face masks and issuing preventative guidance; see Press Trust of India (2015b).
[132] From photo, 13 March 2015.

most of whom have their backs turned to their subject of interest, arms outstretched, as they strain to take selfies with the plane.

The aircraft's fuselage bears the prominent logos and brand names of a raft of sponsors—Solvay, the ABB Group, wines and spirits producer Moët Hennessy, Schindler, Google, luxury watchmaker Omega, and industrial automation company Schneider Electric.[133] I take a few photos of my own, then linger to watch others do likewise (Figure 7), until uniformed security jostle us back out into the daylight. Leaving the hangar, I see a banner for project sponsor Solvay, a Belgian chemical and plastics company, standing on the tarmac. Illustrated with a computer render of a small, two-door concept car, all sleek curves and perforated metal, it asks the question: *'And what if mobility and respect for the environment were utterly compatible?'*

Figure 6. Govt. of Gujarat welcomes Solar Impulse 2, *Times of India*, 11 March 2015.

[133] See Pathak (2015a).

What if mobility and respect for the environment were compatible? Taking *Solar Impulse 2* as an attempt to answer this question, the prototype vehicle is a 'scale-shifting device' (Corsín Jiménez, 2014: 386) freighted with the promise of its own future iterations. For mission pilot Bertrand Piccard, Solar Impulse's central claim was that the vehicle's clean energy technologies could, if scaled up, cut up to half of the world's consumption of fossil fuel energy. (Pathak, 2015b) An object lesson in clean mobility, the prototype aircraft evoked a future world where the tensions between airborne mobility and environmental sustainability would be solved by technology.

Much like the Portuguese sailing ships described by John Law (1984; 1987), *Solar Impulse 2* operated as an immutable mobile. Circulating from Abu Dhabi to Muscat, Ahmedabad, and onward, the plane held its shape, resisting those forces that would rip it apart. Unlike other immutable mobiles, however, *Solar Impulse 2* was a prototype, built to demonstrate the capabilities of renewable energy. Variously described as an 'airborne laboratory', a 'test bed' for complex new technologies, and an 'innovative brand-building exercise' (Pathak, 2015b), the aircraft fulfilled a performative role; its circumnavigation aligning—however fleetingly—the 'multiple, discontinuous social worlds' of Swiss engineers, Ahmedabad residents, international television audiences, and the likes of corporate sponsor Solvay. (Suchman et al., 2002: 176)

Approaching *Solar Impulse 2* as a prototype requires a sensitivity to 'ongoing practices of assembly, demonstration, and performance.' (Suchman et al., 2002: 163) In their research on the working practices of research and development, Lucy Suchman and her colleagues describe how product demonstrations occur at a clearly delineated point in time, targeting specific audiences:

> for management during a presentation aimed at providing reassurance that money has been well spent or at securing funds for further work, for visitors on a tour, or for industry analysts on the floor or a trade show. (Suchman et al., 2002: 172)

The audiences of these demonstrations had an indirect relation to the technology in question—as an investor, buyer, analyst, or professional critic, rather than a user. (Suchman et al., 2002: 172) Solar Impulse's audience was similarly indirect, comprising those witnessing the aircraft in-person, but also international television viewers and press audiences, distributed in time and space. With the mission team reframing renewable energy as both an environmental solution and market opportunity, crowds at the aircraft's

various stopovers constituted a 'promotional public' of affirmative supporters, rather than those directly affected by the technology. (O'Riordan et al., 2017)

Figure 7. Solar Impulse hangar, Ahmedabad International Airport, 13 March 2015.

Though the Solar Impulse mission portrayed itself an experiment, it was, in fact, closer to what Harry Collins dubbed a 'display of virtuosity' (Collins, 1988). With the project's globally distributed 'promotional public' denied access to the 'details of preparation ... the failed rehearsals and practice runs' (Collins, 1988: 728), the mission's circumnavigation mobilised the crowd as a witness, legitimating technical expertise. Despite the lexicon of experimentation, the vehicle's heavily mediatised progress between landing sites served, instead, as a 'spectacular demonstration of [already] consensual knowledge' (ibid: 736). The presence of large crowds signalled the aircraft's significance, enrolling audiences as advocates for Solar Impulse's vision of a cleaner future.

In press coverage, promotional material, and interviews, the mission team repeatedly claimed *Solar Impulse 2* was not built to carry passengers, but a message. (cf. Piccard, 2016) But what was that message? At its simplest, Solar Impulse's record-breaking journey aimed to make the case that the plane's electrical motors, LED lamps,

lightweight materials, and ultra-thin solar cells could be used, 'on the ground', to reduce energy consumption, conserve resources, and 'improve our quality of life.'[134] Building on the ideas of project founder Bertrand Piccard, this message leveraged his family's connection with the 'worlds of exploration and innovation' to 'unite ecology with the economy, environment with finance'[135]. Framing the circumnavigation as an 'adventure' and promoting the prototype aircraft as a 'stimulating image of environmental protection', Piccard sought to channel public enthusiasm by demonstrating new energy technologies could 'achieve what some consider impossible.'[136] It would, he hoped, be possible to channel the resulting public attention to support innovations that could reduce the use of fossil fuels.

In promoting renewable energy, Solar Impulse sought to differentiate itself from 'fringe' environmental movements, whose early monopolisation of renewable energy technologies Piccard believed had impeded its wider uptake.[137] The mission's rhetoric contrasted the activities of these environmentalists, who 'call for reductions in mobility, comfort and growth', with business and industry figures acting to 'defend people's employment and purchasing power.'[138] This enabled Solar Impulse to frame 'clean technology' as a way to transcend an otherwise 'irreconcilable' gap between ecology and the pursuit of profit.[139] As a tangible example of this technology-led approach, *Solar Impulse 2* showed that climate solutions, once seen as an expensive problem, could also be a 'fantastic market opportunity.'[140]

Elsewhere, Piccard spoke out against the 'absurdity' of old polluting systems, while promoting the benefits of new, efficient technological solutions.[141] Contrasting old and new, dirty and clean, he framed polluting, inefficient and unsustainable technologies as remnants of a waning sociotechnical regime. In this account, clean technologies were not simply environmentally beneficial, but contributed to job creation and profitability. Echoing linear models of innovation (cf. Godin, 2006), this posited that new energy technologies originate in scientific research and business R&D, before diffusing to users and specific contexts of application. For Piccard, it seemed that Solar Impulse could best

[134] From Solar Impulse Foundation website, <aroundtheworld.solarimpulse.com/our-story>
[135] From Solar Impulse website, <solarimpulse.com/vision/2004-manifesto>
[136] Ibid.
[137] Ibid.
[138] From Solar Impulse website, <solarimpulse.com/en/our-story>
[139] From Solar Impulse website, <solarimpulse.com/vision/2004-manifesto>
[140] From Solar Impulse website, <solarimpulse.com/vision>
[141] From Solar Impulse website, <solarimpulse.com/vision>

contribute to the uptake of renewable energy by addressing the perceived public relations issue; mobilising a promotional public to accelerate processes of technological diffusion already under way. (O'Riordan et al., 2017)

7.3.b. Placing solar technology

Reflecting on Solar Impulse's time in Gujarat, a central question is how the prototype aircraft came to be in Ahmedabad in the first place. On a logistical level, it would have been easier for *Solar Impulse 2* to use smaller airfields, where less traffic would have allowed for greater flexibility when timing landings. The rhythm of flight legs and stopovers was a consequence of Solar Impulse's round-the-world mission. With time on the ground allowing for repairs, systems calibration, and the exchange of pilots, an accumulation of changing backdrops and local audiences helped the mission team convene a global promotional public in support of their message. Although smaller airports might have required less forward planning, the Solar Impulse team were courted by host countries' airport authorities, who saw benefits in the aircraft's presence. In India, the team secured permission to land in Delhi and Mumbai, but selected Ahmedabad, in part, because two of the mission's technology partners—ABB and Solvay—had factories in Gujarat. (Upadhyay, 2015) Replying to accusations that the mission's Indian stopovers had been chosen at random, pilot André Borschberg asserted that there was Gujarat 'inside *Solar Impulse 2*', through products developed and manufactured in the state.[142] (Upadhyay, 2015; Press Trust of India, 2015a)

A second factor was Narendra Modi's links with the city. Widely recognised as having jump-started India's solar growth during his tenure as Chief Minister of Gujarat, in 2009, Modi launched the Gujarat Solar Power Policy, the first such policy in India[143], which included ambitious feed-in tariffs guaranteed for 25 years. (Sareen and Kale, 2018: 272) By the end of Modi's tenure as Chief Minister, Gujarat had 900MW of solar capacity, more than a third of India's total. (Ramesh, 2014) In 2012, a 4,900-acre plot of government-owned land in Patan, northern Gujarat, became the first in a series of large-scale solar parks hosting multiple smaller developers. (Sareen and Kale, 2018: 274) That same year, a state government project, in partnership with the Indian subsidiary of US company SunEdison, saw PV panels installed atop the state's 12,000-mile network of irrigation

[142] Specifically, he cited the light carbon fibre in the aircraft's chassis, supplied by partner Solvay, who had recently opened an R&D centre in Vadodara, some 70 miles southeast of Ahmedabad.
[143] This preceded action at the national level; in January 2010, the Congress-led government launched India's National Solar Mission, setting a target for 20GW of installed solar capacity by 2022.

canals. (Pandit, 2012; Carrington, 2014) In urban areas, the state supported 'rent-a-roof' concepts, with project developers encouraged to rent rooftop space, erecting solar panels, and selling power to the state electricity distributor. (Ramesh, 2012)

After the 2014 general election, the new NDA government revised India's National Solar Mission's 2022 generation target upwards from 20GW to 100GW; a move largely attributed to Modi himself. (Shidore and Busby, 2019: 1183) Within his first 100 days as prime minister, funding was secured for three new large-scale solar parks, solar-powered irrigation pumps, and canal-top solar plants—emulating models pioneered in Gujarat. (Carrington, 2014) This support for solar came at a time when PV cells were far from cost-competitive with other energy sources; with government funding far exceeding what could be justified by the falling cost of hardware, efficiency gains, or other purely 'techno-economic considerations' (Shidore and Busby, 2019: 1183). Although these policies offered few tangible benefits to India's electricity consumers[144], government support for solar paid political dividends, both domestically and internationally. At home, India's Solar Mission helped the government project a narrative of modernisation and development, while creating a favourable impression among India's more environmentally aware elites. (Shidore and Busby, 2019: 1184) A similar dynamic played out on the world stage, where an active solar policy and aggressive capacity targets positioned India as a climate leader, deflecting criticism of the country's coal consumption and rising emissions. (ibid: 1185-1187)

From the origins of the photovoltaic cell in the 1950s at Bell Labs, solar has been freighted with a moral economy stressing the technology's potentially universal benefit. (Cross, 2019: 52) Too costly to compete with existing technologies, PV found an early use as a power source for satellites and military applications. Following the oil crises of the 1970s, US engineers embraced international development as a context of application, seeing potential markets for photovoltaics in the global south.[145] Solar PV evoked images of a 'decentralized solar future', off the grid, making it possible to produce electricity 'at the point of consumption.' (ibid: 53) With a growing user base coinciding with 1980s-1990s structural adjustment policies, and the deregulation and privatisation of Southern state energy utilities—as in India, post-1991—global financial institutions such as the IMF and World Bank began supporting renewable energy initiatives. Newly embedded in

[144] At the state level, public distribution companies have rendered the specifics of generation and transmission opaque, 'essentially invisible to the voter.' (Shidore and Busby, 2019: 1187)
[145] Through, for example, a 'Solar Energy in the Developing World' conference hosted by the United Nations in 1961.

neoliberal development policies, the PV cell enabled the provision of energy services as a pay-as-you-go basis, through solar-powered water pumps, desalination systems, diagnostic devices, vaccine fridges, and mobile phones. (ibid.)

India's 'incomplete electrification and partial liberalisation' (Sareen and Kale, 2018: 272) should have provided ample opportunities for foreign firms and entrepreneurs in the nation's transition away from fossil fuels. The reality, however, has been far from the decentralised, universal supply envisaged by early solar pioneers (Cross, 2019: 52), with solar uptake striated by the 'thermal hangover' of the country's highly centralised electricity system. (Mohan, 2015) These dynamics are readily apparent in the case of Gujarat's solar parks. Using state-owned 'surplus' land, these parks promised smaller investors fixed tariffs, but also active government shielding and support, encompassing tax and regulatory concessions similar to those in special economic zones (cf. Yeneti et al., 2016: 91; Sareen and Kale, 2018: 275), and state investment in high-capacity transmission infrastructure.

The largest such development in Asia at its completion in 2012, the Charanka Solar Park, in Patan, was hailed as an exemplar of the successes of Gujarat's solar policy, with the state's former energy secretary going as far as to describe the park as Modi's 'PhD in solar energy' (Mohan, 2015). Beyond the headlines, however, this development poses questions about the distribution of benefits and burdens in large-scale renewable projects. The park was built on government-owned 'waste' land, nominally leftover, but key to the livelihoods of Rabari pastoralists, who reserved their customary right, as a Scheduled Tribe[146], to graze livestock on this land. (Yenneti and Day, 2016: 40; Yenneti et al., 2016: 94-96) At the same time, Chararnka's part-mechanisation removed much of the need for labour, contributing little to longer-term, salaried employment opportunities. Early promises of free water, electricity, and new medical facilities remained unfulfilled, while new infrastructure connections—including roads and high-capacity transmission cables—bypassed the existing village entirely. (Hemalatha, 2019) Profits accrued to private developers, and any benefits were felt by those outside Gujarat, as electricity generated in the 'power-surplus' state was exported across state lines. (Yenneti and Day, 2016: 40-41) While solar providers trade on a vision of the PV as 'pre-figurative and pastoral' (Cross, 2019: 62), India's solar parks have been large, centralising installations, shaped by the striating momentum of a long-dominant thermal power sector; and forced to 'fit' a

[146] An officially designated group of historically disadvantaged people afforded reservation status and other forms of positive discrimination by the Indian constitution.

national energy system built by the Nehruvian state as a 'high modernist' expression of development. (cf. Scott, 1998)

Even as Charnaka displaced vulnerable local people, including the Rabari, from the sources of their livelihoods (Yenneti et al., 2016: 97; Hemalatha, 2019), the project was widely promoted on the international stage, one of several highly visible projects that would have contributed to Solar Impulse's decision to land in Ahmedabad. Although these developments belied earlier, utopic visions of decentralisation and grid independence, Solar Impulse avoided taking a position on such questions. Approaching the underlying technology as free from political considerations, the mission's message was, however, congruent with those solar entrepreneurs who claim business can 'do well by doing good', through interventions treating poverty reduction as 'legitimate areas for entrepreneurship and corporate activity.' (Cross, 2019: 48) Solar Impulse's acceptance of the primacy of the market as a 'total moral scaffold' (ibid: 63) closely tracked an emerging 'new business voice' on sustainability and climate issues (Benabou et al., 2017); a message they took to the COP21 climate negotiations, in Paris.

In December 2015, almost nine months after my encounter with *Solar Impulse 2*, members of the Solar Impulse team were at the COP21 United Nations climate conference in Paris. With the support of the UN Environment Programme (UNEP), Solar Impulse's involvement followed the prototype aircraft's positioning as an exemplar and object lesson, able to help attendees reach an agreement. (Solar Impulse, 2015a) Deprived of the physical presence of *Solar Impulse 2* itself, large models of the aircraft were on display in two locations; at Le Bourget, the conference's main venue, in a zone given over to civil society activities, and Solutions COP21, an exhibition showcasing 'solutions' from business and industry. Taking place at the Grand Palais, an ornate exhibition hall built for the 1900 Paris Exposition, Solutions COP21 provided businesses with a space to project a 'common, proactive position' on climate change, bolstering their environmental credentials and 'social license to operate' (Benabou et al., 2017: 58). Organised by two French sustainable development networks, the event promised a scopic overview of products, services, and innovations being developed, in various locations, to combat climate change and its impacts.[147] With both spaces open to the public, members of the Solar Impulse team were

[147] On 4 December, Solutions COP21 was disrupted by environmental protesters, who criticised the event as an opportunity for large, polluting corporations to promote unfeasible, market-based techno-fixes. Once inside, protestors gave a 'toxic tour' of exhibitors' stands, drawing attention to the limits and hypocrisies of the 'solutions' on display, before being expelled by plainclothes police. (de Moor, 2018: 1090)

present, alongside the models, to promote the mission's pro-business, technology-led message.[148]

In these exhibition spaces, models of *Solar Impulse 2* took their place alongside an eco-friendly Korean septic tank, an electric bus concept, and a Google subsidiary's energy-generating kites—examples cited in the team's daily blog dispatches from the conference floor. These posts also highlighted wider applications of the aircraft's innovations; whether the ultralight solar cells developed by Schindler, deployed commercially as part of a solar-powered elevator system; Solvay's energy-dense batteries, adopted in the vehicle fleet of an electric car sharing service; and the light carbon fibre components which kept the plane airborne, used in French firm Kleefer's folding electric scooters. (Solar Impulse, 2015b) Prefiguring these commercial applications, *Solar Impulse 2* was a 'concrete abstraction, carved from and constituting a larger whole' (Højer and Bandak, 2015: 8). As pilot Borschberg explained, it was clear 'that since we were able to fly day and night ... using energy efficient technologies, these [technologies] could also have multiple applications on the ground.' (Borschberg, 2015) Shuttling 'between the general and the specific' (Højer and Bandak, 2015: 8) in the Grand Palais, as in the hangars and on the landing strips of Ahmedabad, Muscat, and Varanasi, the vehicle stood both for itself, and as an example of any number of clean technology and renewable energy solutions; market-ready, and primed for scaling.

Comparing *Solar Impulse* 2's presence in its hangar at Ahmedabad International Airport, and the aircraft models on display at COP21, we can see how the mission's circumnavigation was used to support the claim that clean energy technologies could cut emissions without the need for further-reaching lifestyle changes or imperilling economic growth. For the Solar Impulse team, this message was also envisaged as an immutable mobile, capable of circulating between different locations without distortion or threat to its coherence. (Latour, 1987) At COP21, the aircraft was presented as one in an array of concrete solutions. Team members were on-hand to answer questions and make the link between its affordances and the mission's technology-led message. As a vehicle for this message, the aircraft's efficacy drew on its status as an experimental prototype, freighted with the promise of innovation and renewable energy. In Ahmedabad, the same message relied more on the spectacle of the aircraft's presence; with a Gujarati public queuing for

[148] From press release, 'Solar Impulse Promotes Clean Tech Solutions To Solve Climate Change', Lausanne, 24 November 2015.

hours in the heat, eager to consume the mission's projection of adventure, futurity, and technical expertise.

By identifying *Solar Impulse 2* with Gujarat—'There is Gujarat inside'—and Gujarat with the business-friendly, pro-solar policies of Narendra Modi, the Solar Impulse team elided an apparent contradiction between their business-led messaging and the active, dirigiste interventions of Modi's 'authoritarian developmentalism.' (Mehta, 2010) As prime minister, Modi's championing of solar technologies provided a positive signal for the prospects of renewable energy in India. Solar Impulse's communications highlighted Gujarat's status as the prime minister's home state, with the choice of Ahmedabad as a stopover acknowledged as helping the mission attract press coverage, particularly from the larger Indian newspapers.[149] Linking the arrival of *Solar Impulse 2* with international recognition of Modi's support for solar energy, and the new NDA government's emphasis on development, the resulting coverage 'placed' the mission's solar technology. This attracted local attention, enabling the Solar Impulse team to convene an effective promotional public, with the Gujarati audience's enthusiasm for novelty and innovation proving sufficient motivation—even in the middle of an H1N1 swine flu outbreak.

7.3.c. White flight

Follow me back to that bleached scrub at the airport's edge, where electrical infrastructure towers over a swollen crowd. Waiting, I watch, impassive, as a group of school children in a separate, parallel line are approached by members of the Solar Impulse team. Emerging from their hangar to pose for photos and interact with the crowds, the mission's ground crew is a mix of fit, middle-aged men and credulous twentysomethings, united by their whiteness and a de facto uniform of sponsor-branded navy polo shirts.

As families with young children cut the queue, or give up on waiting and peel away from the crowd, I find myself among a group of younger men, likely college students. Some wear face masks, while others have scarfs pulled tight across their faces, as protection from the H1N1 virus. The crowd smells of sweat. My right leg is shaking, and I shift my weight to steady it. I should have brought more water. As people are let through, the

[149] From YouTube video, 'LIVE: Solar Impulse Airplane – Takeoff from Ahmedabad', 17-18 March 2015.

crowd rushes forward to fill the vacated space. I catch an edge of nervousness in my throat, as the bodies pressing in on me flicker from anticipation and good-humoured boisterousness into something altogether less predictable, then back. After someone steps on my foot, and already expecting the next forward surge, I anchor my body to shield a trio of children sheltering in the negative space in front of my legs.

As we wait, three younger members of the mission's ground crew, two men and a woman with a camera, bring out a stepladder to take a photo of the crowd—an image shared, later, on Solar Impulse's official social media channels (Figure 8). Perching atop the ladder, the photographer gestures to the crowd, trying to fit everyone in frame. As she takes the shot, and begins to climb down, I catch myself speculating about her background and biography; the sequence of choices that delivered her to this point. Time passes. The crowd continues to sluice forward. Later, an older man, again in a Solar Impulse polo shirt, climbs that same ladder. Turning his back to us, he leans out to pose for a selfie, with the crowd as his backdrop. For a split second, I am convinced he will lose his footing and fall, but the moment passes, and he returns to the ground.

Figure 8. Thousands of Indian citizens are coming to #Si2 in #Ahmedabad today!, 13 March 2015

Returning to the airport and my encounter with *Solar Impulse 2*, my aim in this section is to better articulate and probe the disconcertment in my 'body contact' with the aircraft, and my simultaneous enrolment in a promotional public, as participant and voyeur. (Verran, 2001; Nuvolati, 2014) Diverging from the accounts of disconcertment in the previous chapter—the enduring presence of street lighting in the *pols*, my encounter with an urban bicycle-sharing system—this was less a jolt of surprise than a flush of discomfort, emotionally-charged. A detector of difference, this interruption revealed the role of racial difference in the prototype aircraft's stopover in Ahmedabad; an additional dimension to the Solar Impulse mission's mobilities and treatment of place.

Like the rest of the crowd, my presence at the airport was motivated by a desire to see the plane in-person. Familiar with the Solar Impulse mission from its media coverage, the vehicle's arrival in Ahmedabad had struck me as a potentially productive site of inquiry. An unusual application of solar technology, originating outside India, the aircraft's arrival and how it was received could, I suspected, illuminate the mobilities of technology and innovation. This hunch bore the imprint of my own terrains of identity formation (McLaren, 2016: 83), shaped by a preoccupation with how material artifacts track sociotechnical change. The appearance—and undeniable whiteness—of the Solar Impulse ground crew threw me from my expected trajectory. I found myself lost, on one side of a suddenly apparent colour-line dividing the queuing Gujarati crowd from those staffing the mission. (cf. Du Bois, 1903; Elias, 2015) Despite clear differences in age and gender, the crew's varied bodies stuck together, forming a viscous, impermeable whiteness bolstered by their employment status, professional identities, and technological expertise. (Saldanha, 2007) For the queuing Gujarati public, the ground crew were also physically removed, roaming freely beyond a low bamboo barrier policed by local private security.

My disorientation was a result of finding myself on the 'wrong' side of this colour-line. Seeing the crew members moving freely while I remained stuck in the crowd, the aircraft seemed to slip from my grasp. As my time in Ahmedabad had stretched from weeks to months, my status as a raced subject had faded from my conscious awareness, even as it continued to mediate my interactions and body contact with the city. Though I was often asked why I had come to Ahmedabad, pressed to account for my presence in a place with few tourists or Western expatriates, my whiteness saw me treated as a singular outlier or anomaly, a subject of curiosity. This experience at the airport reasserted the presence and effects of racialising systems, as I felt a tug of affinity to the ground crew, and an estrangement from the Gujaratis queuing beside me, rendering me suddenly, but

indisputably, out of place. This embodied experience of disorientation as displacement—of losing my place—revealed the presence of a system dividing subjects by their professional proximity to the aircraft. The differential viscosities of white and Gujarati bodies were one local manifestation of a global colour line produced through the histories of whites' exploitation, oppression, and othering of people of colour. (Elias, 2015: 3)

Standing, sweating, on the wrong side of this line, I felt a flush of resentment towards the ground crew, who had forced me to reckon with my own whiteness. Disoriented and defensive, I found a lightning rod for my resentment in those two photographs described above. In making these images, members of the crowd were desubjectified, becoming a fungible part of Solar Impulse's promotional public. Frozen in place, digital photography nonetheless allowed this aggregate of Gujarati bodies mobile to circulate, reproduced in support of Solar Impulse's message, or as the racialised, exotic backdrop to some team member's selfie. Rather than bracketing or side-lining these details as incidental to the mission's workings, my argument in this section is that they are symptomatic of how the Solar Impulse mission and its prototype aircraft were coded white, as part of a raced and racialising assemblage. (cf. Saldanha, 2007; Weheliye, 2014)

Contrasting these photos of the crowd (Figure 8) with the self-consciously 'heroic' personas of Solar Impulse pilots Bertrand Piccard and André Borschberg, the mechanics of this system of racial ordering became more clearly apparent. Plotted as two poles on a continuum representing subjects' relative proximity to the prototype aircraft, we can picture a transition from the pilots to the ground crew, through local Indian VIPs[150], to visiting school parties and the queuing Gujarati public. On this continuum, we can point to the snaking form of that colour-line, a 'highly crafted string of barriers' dividing social worlds (Elias, 2015), as evidence of the continued workings of India's 'pigmentocracy', in which high-caste Indian subjects have sought proximity to whiteness, while distancing themselves from the country's lower castes. (Dhillon, 2015: 41)

My presence on the wrong side of that bamboo-rodded colour-line troubled an existing order; revealing the limits of a 'material, machinelike' interlocking of multiple components, collections, and flows that figured the aircraft and its mission as white. (Saldhana, 2007: 9) Solar Impulse's whiteness encompassed not just the prototype aircraft, its pilots and ground crew, but framings of the mission, the team's actions,

[150] Local politicians, senior bureaucrats, and business leaders attended events organised by the mission's local host partner, while the Gujarat state government hosted a dinner for the Solar Impulse team. (Ahmedabad Mirror, 2015)

practices, and performances, and innumerable material realities; from the layout of the Monaco control centre to the mission's branded polo shirts, and the curve of the aircraft's wings. Adaptable and highly mobile, whiteness derives strength from plasticity. By specifying the details of Solar Impulse's racialisation, we can better see how the aircraft and its mission reified a whiteness correlated with innovation, adventure, mobility, and technical expertise.

Much of Solar Impulse's whiteness derived from the aircraft's status as a prototype, appearing ahead of its time. Embodying innovation and futurity, the mission's planned circumnavigation served as a visible demonstration of new technical innovations and superior engineering. The crowds at Ahmedabad airport, by contrast, were stuck in the past, subject to the kinds of 'old polluting systems' widely denounced by pilot Bertrand Piccard.[151] Plotting technological difference 'along a single line of development' (Spurr, 1993: 62), Piccard and Borschberg's vision of sustainability enacted a denial of coevalness. (cf. Fabian, 2014 [1983]) By denying the contemporaneity of the mission and its promotional public, Solar Impulse endorsed a model of change where novelty originated in the laboratory, before spreading to users elsewhere. As such, the continuum of proximity outlined above also mapped a hierarchical relationship between 'innovators and their others' (Irani, 2019). Coded white, the mission's performance of innovation and expertise reduced the crowd to passive recipients, consuming a spectacle of technological novelty. Those depicted in the ground crew's photographs were positioned as other to pilots Piccard and Borschberg, and the scientists, engineers, and private firms whose innovations enabled *Solar Impulse 2* to remain airborne. With values of innovation, mobility, and expertise associated with one pole of the continuum, the resulting ordering of bodies differentiated the white 'innovators who find the edges of the future' from those —in this case, Gujarati—'beneficiaries of this avant-garde' (Irani, 2019: 10).

Combining clean technology and a 'pioneering spirit'[152] to achieve the seemingly impossible, Solar Impulse's projections of innovation and futurity aligned with a framing of the mission as an extraordinary 'adventure'. Relying on the pilots' physical and mental endurance—abilities honed during Borschberg's time as a fighter pilot, and Piccard's circumnavigation of the world by balloon—the mission interlocked with a constellation of male-coded whiteness, channelling a pre-war history of aeronautic feats, stunts, and races

[151] In one promotional video, Piccard makes this point by waving a leather pilot's helmet and interacting, awkwardly, with an antique candlestick telephone—see YouTube video, 'Old Techs Are Lame – Climate Change', 30 November 2015.
[152] From Solar Impulse website, <solarimpulse.com/vision>

that had aimed 'to inspire and encourage people in the promise of the aeroplane' (Adey, 2010: 26; cf. Courtwright, 2005; Wohl, 2005). Where these earlier eras' aerial displays were closely associated with militarism and nationhood, Solar Impulse's technology was intended for civilian benefit; paralleling the promises of universal access and limitless power cited by early proponents of the photovoltaic cell. (Cross, 2019: 52) Although Solar Impulse was 'born in Switzerland', the mission presented itself as a 'very multicultural project'[153], making an asset of the diverse fields and nationalities represented by its team members, patrons, sponsors, and technical partners. By stressing that successive Solar Impulse prototypes had 'travelled all over the world ... inspiring people to achieve the impossible'[154], the mission's media and press coverage emphasised the vehicle's mobility and the versatility of its technologies over details of the project's national origins.

Assertations of multiculturalism were, however, belied by the overwhelming whiteness of the vehicle, its pilots, and ground crew. Solar Impulse may have counted diverse nationalities among its members, but details of the vehicle and mission's staging showed continuities with a longer genealogy of Swiss techno-colonialism; a 'colonialism without colonies' (Purtschert, 2016). Lacking colonial territories of their own, and the opportunities for exploration and colonial conquest, Switzerland's invention, conveyance, and teaching of technology and innovation was a 'powerful nodal point' for articulations of whiteness, modernity, and colonial fantasy. (Purtschert, 2016: 55) From the mid-twentieth century, the airplane became the vehicle for a distinctly Swiss 'pioneering spirit'[155], with techno-colonial narratives generating social and cultural capital from depictions of 'racialized others marvelling at Western aircrafts.' (ibid: 61) Combining 'manly adventures' with technical innovation, Solar Impulse's constellation of whiteness tracked these same techno-colonial fantasies, echoing the racialised colonial imagination of Switzerland as 'belonging to a time of progress and a space of modernity.' (ibid: 58, 55)

Promising an ostensibly objective, technocratic view 'from nowhere' (Haraway, 1988: 589), transcending parochial interests, Solar Impulse supported technological solutions with the widest possible application. Situating the mission's message during the livestream of *Solar Impulse 2*'s landing in Ahmedabad, the broadcast presenter described how India, in its capacity as a "very important developing country, a fast-developing country", provided an important audience for the message that sustainable development

[153] From Solar Impulse Foundation website, <aroundtheworld.solarimpulse.com/our-story>
[154] Ibid.
[155] A description similar to the language used by the Solar Impulse mission.

"can be achieved without lowering everyone's quality of life."[156] Supporting a framing of Solar Impulse as global and multicultural, capable of transcending its Swiss origins, this identified its audience in Ahmedabad as local, parochial, and Indian—a distinction mapping, again, to the continuum introduced above.

A powerful illustration of the racialisation of this global-local binary can be seen in the Solar Impulse mission's livestream, broadcasting ahead of the aircraft's expected departure from Ahmedabad.[157] Claiming to "have had a bit of a problem pronouncing the names" of Ahmedabad and Varanasi's airports, the British-Irish broadcast presenter passes over to "our friend" Sujatha Henry, "to help." Responding in a pre-recorded video, Henry, a bespectacled Indian woman sitting cross-legged, in a purple scarf and embroidered *salwar kameez*, is contrasted with the white, square-jawed presenter, wearing another of the mission's branded polo shirts. As she pronounces the airport names—named, respectively, for Vallabhbhai Patel and Lal Bahadur Shastri, leading figures in the Indian independence movement—the video cuts to footage from Ahmedabad, clips layered atop a score of 'remixed' Indian folk music. On a busy street, a mahout sits atop an elephant, flanked by traffic and vendors selling kitchen utensils and furniture. A motorcyclist in a patterned shirt weaves between auto-rickshaws. Market stalls sell umbrellas, leather belts, bags, and shoes. As the clips end, Henry offers a *namaste*, pressing her hands together, and bowing her head. "Namaste to you too, Sujatha," responds the presenter, as Henry's smiling face on the screen is replaced by an image of the *Solar Impulse 2* aircraft; "thank you very much."

One of few acknowledgements of cultural difference in the mission's media output from Gujarat, this exchange is striking in its unselfconscious reproduction of stereotypes and tropes from orientalising and colonial discourse.[158] By having the presenter, a neutral voice of objectivity, enlist Henry's help in pronouncing the 'difficult' name of Ahmedabad's airport, the livestream essentialised the differences between Solar Impulse and its Indian hosts, making only a limited attempts to engage with the particularities of place. Contrasting the prototype aircraft and its crew with an Indian other signified by elephants, street markets, and auto-rickshaws (cf. Said, 1979) reaffirmed Solar Impulse's whiteness. By enlisting Henry, a known 'friend', as the sole representative and spokesperson for the Indian other, the livestream revealed the shallowness of the mission's choice of

[156] From YouTube video, 'LIVE: Solar Impulse Airplane – Landing in Ahmedabad – First Round-The-World Solar Flight', 10 March 2015.
[157] From YouTube video, 'LIVE: Solar Impulse Airplane – Takeoff From Ahmedabad', 18 March 2015.
[158] See Chapter 5; pp. 91–93.

Ahmedabad as a stopover location. Despite the apparent attractors of Modi's solar policy actions and the local presence of mission technical partners, it seems Gujarat and Ahmedabad were ultimately little more than a colourful, exotic backdrop for the prototype aircraft's technology, engineering, and innovations. (cf. Spurr, 1993: 142)

The aircraft's whiteness was also, crucially, correlated with its mobility. Traversing long distances under its own power, the mobility of *Solar Impulse 2* followed the mission's goal, having been engineered as an immutable mobile, building support for a clean energy as it moved between locations. This contrasted with the relative immobility of the mission's local audiences, with many of those queuing at Ahmedabad airport remaining viscous with the national territory, striated by borders, and stuck in place. An incident from the team's attempts to leave Ahmedabad, ahead of an onward flight to Varanasi, shows the mission's whiteness interlocking with *Solar Impulse 2*'s spectacular mobility.

When a planned departure was delayed by bad weather (Vora, 2015), the rescheduled take-off was blocked by what the Solar Impulse team described as 'tedious paperwork' (Joshi, 2015). With uncertainty about whether the aircraft would be permitted to leave, the livestream jumped between Ahmedabad airport, where plane and pilot waited on the runaway; mission control in Monaco; and the broadcast studio, where the presenter sought clarity from the mission director:

> Mission director: "The plane is ready, André [Borschberg] is on board, we still have 30 minutes from take-off, and it's just to receive the release from the administrative ... there, I think it's with immigration, and I'm a little bit surprised ... from a technical point of view, weather and everything looks fine."
>
> Presenter: "We're expecting a man to be running across, brandishing a piece of paper saying 'right, now you have permission to take off.'"[159]

Although this incident was resolved in a matter of hours[160], the hold-up shows how even a minor setback destabilised Solar Impulse's self-image, revealing limits to the mission's mobility and ostensibly universal, pro-business message.

Appearing on the livestream, Solar Impulse's marketing manager described how the aircraft's supporters were appealing directly to Modi over social media, petitioning him to resolve any administrative issues, and decrying the mission's customs blockage as at odds

[159] From YouTube video, 'LIVE: Solar Impulse Airplane – Takeoff from Ahmedabad – RTW Attempt', 17 March 2015.
[160] It seems Bertrand Piccard, who had piloted the aircraft from Muscat to Ahmedabad, had left the airport area without first obtaining the necessary clearance from Indian immigration and customs. (Sen and Masih, 2015)

with the government's wiedly-promoted 'Make in India' campaign.[161] The implication was that this hold-up threatened the NDA government's performance of a 'new' India freed from bureaucratic red tape (Joshi, 2015), escaping the colonial past to take its place as a global economic power. (Kaur, 2012: 604; Kaur and Hansen, 2016: 266, 270) Manifesting as a holdover of the 'permit-license-Raj'[162], Solar Impulse's run-in with immigration and customs, and the resulting delay, evoked memories of a pre-reform, Nehruvian 'old' India. Piccard's subsequent 'attack on Indian bureaucracy', blaming the delay on 'administration, papers, stamps', invoked the shackles of Nehruvian planning and state bureaucracy to produce an arrested image of the Indian economy. (Joshi, 2015; Bhabha, 1994: 75) Responding to this obstacle to the aircraft's departure, the mission's representatives portrayed India's bureaucracy as cumbersome and regressive, but also sadly inevitable—the consequence of an essential difference between the global, forward-looking prototype aircraft and its recalcitrant hosts.[163]

This incident reveals how the Solar Impulse mission envisaged technology as a stable object with fixed characteristics, emerging from a 'core', and providing benefits to grateful recipients in the periphery. (Garb and Friedlander, 2014: 15) This journey was expected to be smooth, relying on clear demand, and facilitated by the technology's obvious advantages. (ibid.) Representing an abrupt interruption to its plans, and something human, rather than weather conditions or technical error, the mission's tussle with Indian customs reveals how movement is a 'socio-spatial, power-laden process' (McCann and Ward, 2012: 329). Although Solar Impulse functioned effectively as an immutable mobile, the mission and its message were too 'rigorously bounded' (de Laet and Mol, 2000: 226), making few concessions to local culture and circumstances. Travelling to 'unpredictable' and 'intractable' places, the mission imposed itself on its hosts, proving brittle and inflexible where a fluid, responsive object may have been more effective in achieving its goals. (ibid.)

[161] From YouTube video, 'LIVE: Solar Impulse Airplane – Takeoff From Ahmedabad', 18 March 2015.
[162] A term coined in 1961 by politician C. Rajagopalachari, to label and critique the kind of centralised economic planning promoted by Nehru and the ruling Congress Party in the years following Indian independence.
[163] One voice of dissent came from pilot André Borschberg, for whom any issues imply reflected how different countries had 'different styles and ways of doing things', requiring the mission team to adapt to local circumstances and cultural norms. (Solar Impulse livestream, 2015)

7.3.d. Discussion

Solar Impulse 2 was freighted with the promises of a clean energy future. As a prototype, demonstration, and display, it communicated the effectiveness of technologies that the mission and its business partners saw as market-ready, primed for wider deployment and scaling. The success of their 'solutions'-based message was contingent on the aircraft completing a planned circumnavigation of the globe, attracting media coverage as it progressed between locations. Motivated by the in-state presence of factories owned and operated by the mission's technology partners, and Modi's efforts to support the roll-out of solar generation capacity in Gujarat, the mission's choice of Ahmedabad as a stopover location seems to have been part of an attempt to align its message with the policies and priorities of the Indian government. Contrasting Gujarat's experience of solar power and energy policy with the Solar Impulse team's activities at the COP21 Paris climate negotiations, I argued that Solar Impulse's message had little to say to the Gujarati public about the specifics of place, so fell back on technological spectacle, projecting an image of modernity and development for an appreciative local audience.

In prioritising the aircraft's status as spectacle, the mission essentialised the difference between the aircraft, pilots, and crew, and its Gujarati hosts and queuing promotional public. My own disconcertment while queuing at Ahmedabad airport highlighted systems of ordering difference—by race, gender, age, nationality, mobility, technological advancement, and proximity to the prototype aircraft. In this case, the *Solar Impulse 2* was able to elide its Swiss origins and associate itself with white-coded values of modernity, innovation, and mobility, as mission representatives stressed the universal applicability of their technology-led message. Instrumentalised as a promotional public, the Gujarati crowds queuing to see the aircraft were desubjectified; represented as local, immobile, and passive recipients of new technology emerging from a developed core. With articulations of the local and global emerging as a crucial site of differentiation, the Solar Impulse mission shows how some people, entities, images, and objects are able to move freely across national borders, while others are stopped, prevented from doing so. These differential mobilities contributed to Solar Impulse's whiteness, interlocking with the aircraft's prototype status, the mission's performance of 'adventure', and the team's efforts to represent the interests of an unmarked, universal subject.

7.4. Discussion: Mobile infrastructures?

Further probing the relations between infrastructure and urban change, this chapter focused on the variable mobilities of technology and infrastructure. Exploring two cases, a satirical Facebook post about the transplantation of Japanese-designed roads and a stopover by Swiss prototype aircraft *Solar Impulse 2*, the presence of 'foreign' technologies illuminated questions of context and cultural difference.

Beginning with a close reading of a piece of viral media satirising dominant discourses around modernisation and infrastructure-led development, I traced how this used parody and caricature to critique the NDA government's approach to infrastructure-led development. Claiming to depict a 'new' road transplanted from Japan, the presence of untranslated kanji road markings signalled a failure of development, even as the image's caption hailed the road as a triumph for Modi and the Indian government. With Japanese development assistance stressing the role of knowledge transfer and social learning, the depicted failure is particularly acute, with rapid implementation and a lack of oversight resulting in inappropriate infrastructure, ill-suited to the needs of its local users. Contrasting this parody with an actual 'smart road' project implemented in Ahmedabad with Japanese support, I concluded this section by reflecting on the significance of efforts to tailor this infrastructure model to better suit the cultural and linguistic contexts of the Indian subcontinent.

In the second case, solar-powered aircraft *Solar Impulse 2*'s arrival in Ahmedabad provided a strategic site to probe the promotion of renewable energy technologies, and how this message was received by Gujaratis and the Indian media. Exploring how the aircraft and its round-the-world mission worked to spread a particular message, I traced how the Solar Impulse mission framed the mass adoption of renewable energies as the best way to promote sustainability, an approach facilitated by private sector innovation. The mission's message made few concessions to its local audiences and context, effectively ignoring the critical role of the state government in supporting Gujarat's successful solar energy sector. Attending a 'public day' at Ahmedabad International Airport, with the intent of seeing the aircraft first-hand, in the final part of this section, I shared my disconcertment upon being confronted with the whiteness of the mission's ground crew—an experience that prompted urgent questions around the role of race and whiteness in mediating the aircraft's mobilities, message, and mission.

Reading across these cases reveals the limitations of linear and diffusionist models of technology transfer, innovation diffusion, and sociotechnical change. In both cases, the arrival of ostensibly 'foreign' technology highlighted disavowals of the coeval existence of 'innovators and their others' (cf. Irani, 2019). Contrasted with Varanasi's existing roads, the Japanese equivalent appeared as unimaginably advanced. Laden with the promises of modernity, it was as if the road's transfer from Kyoto would allow India to leapfrog any intermediary stages of development, delivering its users into a possible future. Similarly, for those Gujaratis queuing at the airport to see *Solar Impulse 2*, the prototype aircraft was a technological spectacle, embodying values of innovation and expertise, and representing a tangible application of advanced technology. For the Solar Impulse mission, however, Ahmedabad was treated as little more than an exotic, colourful backdrop, its residents backward and peripheral, characterised by their remoteness from a more technologically advanced 'core'.

In each of these cases, a failure to acknowledge and accommodate differences in local context reveals a failure mode peculiar to the immutable mobile, and contingent on its mobility. In the next chapter, I develop this line of analysis further, using an idiom of 'worlding' to address constitutions of context by different infrastructures and urban technologies. As a prelude to my final evaluation of 'appropriateness' as a normative criterion for appraising infrastructures, 'worlding' approaches context not as a static backdrop, congruent with the sociocultural or biophysical environment, but an active accomplishment, produced through materiality, discourse, and social practice.

Chapter 8: Worlded infrastructures

8.1. Introduction

In this chapter, I turn to questions of ontology, aligning my study with work that has taken the 'very existence or being of entities' as its central focus, and showed, 'in practice, and in detail', how 'particular ontologies are achieved.' (Woolgar and Lezuan, 2013: 335, 336) Concerned with forms of difference that 'cannot be reduced to a disparity of 'worldviews'' (ibid: 322), this work breaks with perspectivism, which focuses on how things are imagined and represented, but neglects the 'resistances, liveliness, or agency of what is being perceived.' (Sismondo, 2015: 444) Looking instead at what STS researcher Christopher Gad and his colleagues have termed 'practical ontology', this work instead explores how actors—of all kinds—are engaged in constituting worlds. (Gad et al., 2015: 75)

Where STS researchers Steve Woolgar and Javier Lezaun focus on generative practices of world-making (2013: 324), I speak instead of worlding[164]—using anthropologist Anna Tsing's term for the 'attribution of world-like characteristics to scenes of social encounter.' (Tsing, 2010: 48) Specific instances of worlding comprise 'propositions about context' (ibid: 49); processes by which the near and far 'intermingle', such that 'apparently diverse scenes may become part of the same picture, or narrative.' (Hastrup, 2013: 149) Always experimental, usually partial, and 'often quite wrong' (Tsing, 2010: 48), worldings reveal how different actors 'locate the contours and parameters of the contexts in which they act.' (Stead, 2016: 33)

A focus on worlding practices also offers a way to move beyond accounts of the globalisation of infrastructure and urban development, which flatten analyses of sociotechnical change by falling back on simple binary oppositions—in particular, a global-local dyad in which 'the local' too often denotes anything that 'not global.' (Fan, 2016: 359). More so than totalising theories of globalisation, worlding 'lends itself to an awareness of multiplicity' (Stead, 2015: 31). Addressing the practical enactments and material effects of global, local, transnational, and indigenous identities, a worlding lens offers a useful corrective to many globalisation narratives, which rely on images of the

[164] I also distinguish my use of 'worlding' from that of Ananya Roy and Aihwa Ong (2011), who, in their edited volume *Worlding Cities,* trace a different conceptual genealogy (via Spivak, 1999). Their use of the concept is narrower than my own, limited to 'projects that attempt to establish or break established horizons of urban standards in and beyond a particular city.' (Roy and Ong, 2011: 4)

'global' as a singular, totalising sphere somehow 'abstracted from place' (Stead, 2016: 34). Worlding practices, by contrast, are neither linear nor uniform, characterised instead by a 'constant moving about and bending and stretching [of] particular perspectives' (Hastrup, 2013: 161). This characterisation of worlding practices shares much with the work on practical ontology identified above. Both approaches (1) emphasise *enactment* over construction; (2) acknowledge *multiple ontologies*; and (3) *refuse a recourse to context*, as a 'explanatory staple' (Woolgar and Leuzaun, 2013: 324), external to the objects or entities in question.

Firstly, worlding practices enact worlds. As shown in earlier chapters, use of the term 'construction', as applied to technology and extended to patterns of sociotechnical change, has conveyed the idea that objects start with no fixed, essential identity:

> During their unstable childhoods their identities tend to be highly contested, volatile, open to transformation. But once they have grown up, objects are taken to be stabilized. (Mol, 2002: 42)

Exploring the cross-cutting mutabilities and obduracies of infrastructure, Chapter 6 contested unilinear theories positing one-way progression from flexibility to stability. Following Annemarie Mol, it is no longer tenable to assume objects 'gradually acquire an identity that they then hold on to' (Mol, 2002: 43). Instead, a given object's stability is an effortful achievement, contingent on practices of maintenance and upkeep. By moving beyond biographies of objects as products of a 'contested and accidental history' and rooting our analysis in a 'complex present' where identity is fragile and may vary, we can better appreciate how the same object might be differently—or multiply—enacted. (ibid: 43, 180)

Secondly, and emphasising enactment, notions of worlding diverge from a 'one-world metaphysics' (Law, 2015: 129) in producing accounts of multiple ontologies, enacted through practice. (cf. Mol, 2002; Sismondo, 2015) Challenging presumptions of stability or completion, practical ontology undercuts assertions of a 'singular, ordered world' (Woolgar and Lezuan, 2013: 323). Realities soften and worlds multiply (Mol, 2002: 4-5), produced through 'contingent and heterogeneous enactments, performances or sets of relations.' (Law, 2015: 127) Through attentive empirical research, this work follows actors handling 'multiple realities and the contingent business of trying to patch these together' (ibid: 130); responding to clashes and non-coherence through, for example, denial, domestication, separation, or care. (Law et al., 2013)

Third and lastly, this work refuses a recourse to context, one of social scientists' 'explanatory staples' (Woolgar and Lezaun, 2013: 324). As Woolgar and Lezaun argue:

> Objects do not acquire a particular meaning in, or because of, a *given* context; they cannot be accounted for by reference to the external circumstances of their existence. (Woolgar and Lezaun, 2013: 323)

Instead, objects enact and order their contexts through practices; crystallising, at least provisionally, a given world or reality. (Woolgar and Lezaun, 2013: 323-324) Actors' determinations of what qualifies as 'context' can be critical to a given entity's ontological status, something that otherwise might be 'up for grabs.' (ibid: 327, 334) Context, in this telling, is not self-evident, an inert backdrop inherited fully formed. It does not precede objects or entities, but is enacted through practices of worlding.

Extending this approach to my research, this chapter examines different actors' worldings of infrastructures, technological artifacts, and urban reconfigurations. In the following sections, I bring the notion of worlding to bear on two cases from my research in Ahmedabad, foregrounding situations where different worldings—and *worlds*—exist in tension or competition. In the first case, I describe an encounter between two divergent worldings of the bicycle. Using this to trace the classing and gendering of the bicycle, and, by extension, questions of mobility, a greater appreciation of practices of worlding reveals how gender, class, and cultural identity can mediate a given artifact's enactments and use. Taking a similar approach to Ahmedabad's built environment, the second case focuses on the redevelopment of the Sabarmati riverfront, a space previously claimed by slum-dwellers and the city's urban poor. Tracing planners and visitors' worlding practices through material traces in park gates and ticket booths, real estate hoardings, an amphitheatre space, and riverfront promenades, I show how the development has re-worlded the space as a blank slate, amenable to development, and open to capture by the city's middle classes.

Together, these cases further develop the preceding chapters' critiques of the construction and stabilisation of technology, and linear, diffusionist models of innovation and sociotechnical change. Treating context as a relational property, enacted or choreographed through practice, these accounts of worlding and practical ontology provide a foundation for my concluding reflections on 'appropriateness' as a criterion for evaluating infrastructure.

8.2. Re-worlding mobilities

8.2.a. Pedal for Fun

Waiting nervously outside the offices of accountants V. K. Soni and Company, ahead of a meeting with MYBYK founder Arjit Soni[165], I tumble into conversation with the co-founder of a local cycling group, Pedal for Fun. Established by a group of cyclists who got to know each other cycling in Ahmedabad and its hinterland, Pedal for Fun meets regularly for treasure hunts, picnics, group rides, and other organised events. Like me, the co-founder is here to meet Arjit, hoping to convince him to lend out some bicycles from MYBYK's fleet for a charity cycle ride the following Sunday. Timed to run close to International Women's Day[166], this all-women event, he explains, is raising funds for 'Women on Wheels', an NGO project training poor woman for work as paid drivers.[167]

Browsing the cycling group's Facebook page some days later, I scroll through a proliferating grid of images. Photos of young men and women, mugging for the camera, with water bottles and backpacks, in helmets and reflective strips, at a big-box sporting goods store for a night ride. Motion blur, car headlights. The handle of a selfie stick, overexposed, catches a group of cyclists at an intersection. The same faces on dirt roads, in shorts and sunglasses, posing for a group photo at an archaeological site, long shadows in the afternoon sun. Route directions overlaid on Google Maps screenshots: 42 minutes by car. Shots, too, of the aforementioned women's cycle ride: a man in a yellow cap holds a bunch of pink and white balloons raised above his head, a convoy of cyclists pick their way through cars, mopeds, auto-rickshaws—and yes, the bright green wheel arches of the MYBYK livery, instantly recognisable. A dozen people posing with an oversized cheque for 20,000 rupees. A press cutting from Indian broadsheet *DNA:* '*Women cycle to raise fund for their underprivileged counterparts*.'[168]

During this conversation outside the accountants' office, I became aware of the gap between at least two different worldings of a common artifact: the bicycle. For Pedal for Fun's founders and membership, cycling was a recreational activity. For Arjit Soni, the bicycle was a utilitarian technology; a possible solution for the 'first and last mile' of Ahmedabad residents' daily commute. Courting Soni's support for the charity ride, Pedal

[165] An encounter described in Chapter 6; pp. 142–144.
[166] A United Nations-backed focus point in the international campaign for gender equality and women's participation in economic and political activities.
[167] From field notes, 4 March 2016.
[168] From Daily News & Analysis (2016).

for Fun's hope of success was predicated on a recognition that, despite their differences, the two parties shared an understanding of the bicycle—and cycling—as modern and socially respectable. This followed these two groups' respective efforts to differentiate their worldings of the bicycle from a dominant local perception, which associated the technology with a low-caste, low-income user base.

For STS scholars, the bicycle has long been an exemplar case, its history and evolution offering a familiar hook for reflections on the stabilisation of technology. (Bijker, 1995; Woolgar and Cooper, 1999) But as Fa-ti Fan argues, constructivist STS has tended to produce 'case studies in snapshots of time' (Fan, 2016: 365), an output ill-suited to the analysis of macro- and long-term structural factors, including culture. 'Would the theory [of SCOT]', he asks, 'have looked the same if it had been developed to explain everyday technologies of transatlantic slaves or [the] hydraulic engineering of an authoritarian bureaucratic state?' (ibid.) Defended by its advocates as a bundle of concepts easily mobilised, independent of their terrains of formulation, Fan argues that SCOT's Euro-American origins have moulded its outputs, placing limits on its generalisability.

Reacting to these limits, Fan calls instead for middle-range theories demonstrating 'historical thickness' (Fan, 2016: 365). As applied to the bicycle, a historically 'thick' account must start by recognising that, at least initially, countries like India were the recipients of 'machines whose design and utility had been established in and for very difference societies.' (Arnold, 2013: 41) Granted access to the bicycle once it was no longer flexible, Indian cyclists were excluded from the technological frame that could have mediated the technology's further modification. (cf. Bijker, 2010: 69-70; Arnold and DeWald, 2011: 972-973) The social construction of the bicycle, in short, happened elsewhere—rendering the technology, in its early days, no less foreign than Swiss solar aircraft or Japanese bullet trains. In this, SCOT's formulation of *relevant* social groups is loaded, any questions of 'relevance' inflected by acute asymmetries in the relative power of social groups in the metropolitan core and colonial periphery.

For colonial subjects at the turn of the twentieth century, the bicycle offered a new physical freedom. (Arnold and DeWald, 2011: 981) A high-status commodity good, coded as white, based on its association with authority[169] and European mobility practices, the bicycle could, nonetheless, 'hardly be restricted to European or official use.' (ibid: 995) Seeking greater proximity to whiteness and modernity, middle-class Indians mimicked

[169] Following its uptake by Indian governments at all levels, for use by telegram delivery boys, postmen, district judges, police superintendents, etc. (Arnold and DeWald, 2011: 979, 981)

European recreation practices, with male students from high-caste families participating in cycle tours and competitive races. (Arnold and DeWald, 2011: 983) By the 1920s, as Indian bicycle-users became more common, remaining white cyclists were likely to be relatively low status; operating at some distance from the ruling elite. (ibid: 982)

As cycling spread, the bicycle's early connotations of status and modernity passed to the motorcycle and automobile, modes of transport preserving the separation between European colonisers and their colonial subjects. (Arnold, 2013: 83) Abandoned by its high-status European users, the bicycle became an everyday Indian technology, amenable to local adaptation, and quickly 'absorbed into the working lives of the [nation's] lower classes.' (Arnold and DeWald, 2011: 995) Severed from its previous associations, Indian users were able to re-world the bicycle as an indigenous technology, and a route to physical health and national self-sufficiency. (Arnold, 2013: 106) Scaled to the level of the nation, this worlding survived India's transition to independence, but by the time of my own research in Ahmedabad, the connotations of the bicycle, as a technological artifact and mode of transport, had shifted once more.

As a way of lending greater thickness to my analysis, these histories show how, in India, the bicycle—an ostensibly stabilised technology—was enacted differently by European actors and colonial subjects. Returning to the meeting between Pedal for Fun's co-founder and MYBYK's Arjit Soni, an attention to practical ontology reveals how different cycling practices in 2010s India produced different enactments of the bicycle. Taking the above encounter as a point of departure, in the next sections, I show how these enactments enabled different groups to improve their position in a vehicular hierarchy of value. (cf. Wilson, 2013; Arnold, 2012) With this as a common goal, and despite clear differences in their respective worldings, Pedal for Fun and MYBYK saw benefits in cooperating, making common cause to overcome long-held perceptions of the bicycle as a stigmatised mode of transport.

8.2.b. Re-worlding the bicycle

Writing about cycling and class identity, anthropologist Manisha Anantharaman shares a vignette of an old man passing the inauguration of Bangalore's highly anticipated cycle network:

> Dressed in a *dhoti* and riding a rusty, Indian-made bicycle, he stopped briefly, looked at the gathering, and rode on. (Anantharaman, 2017: 865)

Impassive and uninterested, Anantharaman contrasts this old man with members of the city's Go-Green Cycling Group, riding high-end bicycles, and united by their signature t-shirts, helmets, and cycling gear. (ibid.) With similar dynamics present in Ahmedabad, Pedal for Fun and MYBYK's recreational and utilitarian framings of the bicycle diverged from a long-established third frame, embodied by this *dhoti*-clad man. This frame cast cycling as a remnant of 'old' India[170]; a low-tech mode of transport associated with poverty and a low-caste user base. Arjit Soni conceded the reality of this stigma while downplaying its salience; implying it was unlikely to be a significant barrier for MYBYK's target users.[171] As he described it, Indians might recognise the perception of cycling as low-class or 'backward' as a belief held by others, but it was never something they would own or assert themselves.

The social reality of this stigma is captured in a scene from the trailblazing 2014 Gujarati comedy, *Bey Yaar*, in which Chako, the film's young protagonist, asserts:

> "You know my grandpa rode a cycle. My dad rode a scooter. And I ride a [motor]bike. I might buy a Nano[172] someday." (Jain and Jain, 2014: 0:20:34)

This line of dialogue maps a narrative of technological uplift to a sequence of vehicles.[173] This ordering reflects the importance of automobility to the film's young, urban target audience—many of whom would have been members of the aspiring 'neo-middle' classes targeted by Narendra Modi and his BJP allies. (Jaffrelot, 2013) For these viewers, bicycle users were presumed to be resource-constrained cycling 'captives', with limited mobility choices. (Brussel and Zuidgeest, 2012) Where Indian films once featured cyclists as working-class heroes, the bicycle now all but disappeared from the movies. (Joshi and Joseph, 2015: 23) With growing access to self-consciously 'modern' cars, mopeds, and motorbikes, the country's cinema-going classes no longer see the bicycle as a subject of aspiration and desire.

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[170] Reflecting popular lamentations of India as divided between a 'new' India that can 'produce a recognizably modern standard of living' and a recalcitrant 'old' India that 'blocks this vision of development' (Irani, 2019: 10)

[171] From field notes, 4 March 2016.

[172] Launched in 2009, the Nano was marketed as a low-cost 'people's car', priced at a level that brought car ownership within the reach of middle-income families. Contrary to expectations, demand and sales proved sluggish, as the vehicle's simple design failed to provide the symbolic advantages of car ownership: 'In short, there was nothing to brag about.' (Nielsen and Wilhite, 2015: 381)

[173] On rhetorics of uplift in colonial discourse, see p. 93.

If this line of dialogue registers cycling's stigma, a second, more tangible trace can be seen in Ahmedabad's built environment, where an uneven implementation of bike lanes has caused enduring trouble for cyclists. Recognising the continued importance of non-motorised transport in the city (cf. Wilson, 2013), the Janmarg BRT development's first phase saw wide bus corridors paired with segregated cycle lanes and footpaths, while narrower stretches used road markings to carve out space for cyclists. (Kadri, 2010) For the second phase, however, much of this dedicated cycling infrastructure was scrapped in favour of a widened footpath, a choice justified by the openings needed to access roadside properties.

By the time of my research, most of the lanes from the first phase were in a clear state of disrepair; interrupted by open manholes and stormwater drains, appropriated by motorbikes and auto-rickshaws seeking to leapfrog congestion, and encroached on by vendors and parked vehicles—factors forcing pedestrians and cyclists into the road. (Gautam et al., 2014: 40, 46; Bansal, 2015) For transport researchers Rutul Joshi and Yogi Joseph, this appropriation and neglect of cycle lanes is symptomatic of cyclists' low position in the city's transport hierarchy (Joshi and Joseph, 2015: 31); part of an 'infrastructural settlement' reflecting received ideas about how the reconfigured urban streetscape will be used, and by whom. (Latham and Wood, 2015: 301) With no barriers or hard protection, this flawed implementation of cycling infrastructure shows the low stakes in accommodating non-motorised transport.

In this context, groups like Pedal for Fun show how entrenched, often stigmatised framings of cycling practices are being undercut and reworked by transnational forces. (Anantharaman, 2017: 870) In urban India, expensive, high-tech bicycles have become fashionable, and rallies and long-distance events are increasingly common. (Joshi and Joseph, 2015: 29) For Anantharaman's interlocutors, IT workers in Bangalore, exposure to recreational cycling during work trips to Europe and California has had a lasting impact; turning bicycle use 'from a practice of deprivation to an act of self-improvement, enjoyment, and environmentalism.' (Anantharaman, 2017: 878) In Ahmedabad, photos on Pedal for Fun's Facebook page show a membership drawn from a similar demographic: middle-class individuals in their 20s-30s, mostly men, participating in weekend rides, rallies, and races.

The charity cycle ride is an exceptional case, diverging from Pedal for Fun's typical weekend pursuits. To get a clearer sense of how this event relates to the group's other

activities, and how they experience the city, I make two sets of comparisons—first, with anthropologist Ashley Carruthers's research on the uptake of sport cycling among Vietnam's urban elite (Carruthers, 2018), and second, a promotional electric moped ride in Ahmedabad, promoted by the Confederation of Indian Industry, among others. Contrasting these cases with my own observations sharpens my analysis of Pedal for Fun's key features, enabling me to explain how this fundraiser contributed to a differential worlding of the bicycle.

On the streets of Hanoi and Da Nang, as in Delhi and Ahmedabad, 'spandex-clad cyclists on carbon road bikes costing thousands of dollars ... are now a common sight' (Carruthers, 2018: 1). Focusing on these elite cyclists' appropriation and reworking of new roads, Carruthers describes how Vietnam's automotive infrastructure has become a space for 'play and display.' (ibid.) As in India, recreational cycling is increasingly a subject of curiosity and interest among Vietnam's urban middle classes, but for manual workers, cycling is stigmatised as a low-status activity. For wealthier individuals, the pursuit of recreational cycling therefore requires symbolic separation from the everyday practices of the country's urban poor. To assert this distinction, bicycle use is conspicuously worlded as 'sport cycling', given context through elite participants' membership of a transnational community of practice. (ibid: 10)

The presence of sport cyclists on Vietnam's new roads—often funded with Japanese or Chinese development loans—cuts against an infrastructural settlement made in anticipation of an emerging, state-endorsed automobility regime. Intended to catalyse the formation of a new, 'civilised' automotive subject, these roads were expected to affirm the desirability of the private car, while denigrating the risky, polluting motorcycles used by most Vietnamese. (Carruthers, 2018: 2, 4-5; Hansen, 2017) At a material level, however, these newly built roads offer 'smooth surfaces and unimpeded stretches of tarmac' well suited for cycling; with Carruthers's interlocutors leveraging their elite status to disregard and, in some cases, *adjust* restrictions on road use. (Carruthers, 2018: 15-16) In Hanoi, for example, sport cyclists appropriated a new airport road as an informal racecourse, hosting races in the guise of 'training' rides, three mornings a week. (ibid: 18) Confronted with such activities, local authorities and road users had little choice but to yield to the group's appropriation of bridges and highways as 'their own private playground.' (ibid: 19)

In occupying newly built roads, the sport cyclists profiled by Carruthers enjoy an unusual latitude of action, suggesting their efforts to differentiate their activities from the

cycling practices of Vietnam's urban poor has been successful. Many of Pedal for Fun's membership may superficially resemble these sport cyclists, particularly in their use of high-value road bikes and gear to assert their social standing. However, drawing their membership from the professional middle classes, India's urban cycling groups lack the social and political influence of Carruthers's research subjects. With fewer resources at their disposal, their re-worldings of the bicycle are, consequently, less assured; a partial and precarious accomplishment. Indian cyclists, regardless of class or the material specifications of their bicycle, are vulnerable to the vicissitudes of an often-unforgiving urban environment; forced to 'jostle with aggressive automobiles, harassed by cops, [while] breathing polluting air, [and] sweating in the unforgiving Indian sun' (Anantharaman, 2017: 870).

Figure 9. Request you to please join us for Gujarat's first Electric Vehicles Drive, 10 April 2016.

Where this first comparison looked at at cycling practices in urban India and Vietnam, my second comparison puts Pedal for Fun's fundraiser into dialogue with another public-facing event, taking place in the same city. I start by sharing a poster I encountered during my final weeks of fieldwork (Figure 9), promoting a forthcoming electric moped rally, or e-Bikeathon. Promoted as a 'step towards smart [and] green mobility', the event was organised by the Gujarat Knowledge Application & Facilitation Centre, a joint undertaking by Gujarat's state government and the Confederation of Indian Industry. Flagged off by Ahmedabad's mayor and municipal commissioner, over 100 participants took to the city's streets on electric mopeds provided by local manufacturers. (Times News Network, 2016) Riding shoulder to shoulder for the duration of the 20km route, the participants' presence on the city's roads was a public spectacle and demonstration of the new vehicles, uniting onlookers and attendees as a de facto promotional public. (O'Riordan et al., 2017)

This e-Bikeathon's success relied on a temporary appropriation of Ahmedabad's roads; the organising agencies' goals fulfilled by the sudden, visible presence of electric mobility technologies in shared public space. But where the e-Bikeathon used this visible presence to legitimise electric mopeds in the eyes of an appraising public, the Pedal for Fun fundraiser used a similar strategy to direct attention to a charitable cause. Like this e-Bikeathon, and those Vietnamese sport cyclists (Carruthers, 2018), the charity fundraiser's success relied on participating cyclists' appropriation of the city's road infrastructure. Photographs from the fundraiser show the group on Ahmedabad's streets.[174] Posted on the group's Facebook page after the event, one image shows roughly 30 participants, dressed in white and pink.[175] Moving as a group, these cyclists occupy the outer edge of a carriageway flanking a dedicated Janmarg bus lane, alongside cars, motorbikes, and an auto-rickshaw. A segregated cycle path remains unused. A couple on a motorbike stop to watch the group pass, while passengers lean from their vehicles to take photos.

As with the *Happy Streets Ahmedabad* campaign, this occupation of the city's roads was motivated and mediated by its participants and organisers' class identity. In this, the charity bike ride could be part of a trend for 'altruistic faddism', common among Ahmedabad residents in their twenties and thirties. As author Amrita Shah describes:

[174] From photographs, 7–13 March 2016.
[175] From Facebook group image, 'Women on Wheels Ride, Ahmedabad', 13 March 2016.

> I hear of … a group of do-gooders that offers free tea and bananas to cyclists; of another group that hopes to spark off chain reactions through acts of kindness such as helping the elderly cross the road; and yet another group that feeds two hundred people every Sunday in the old city. (Shah, 2015: 162)

Lacking the resources of Carruthers's elite interlocutors, or the e-Bikeathon's explicit government backing, Pedal for Fun's appropriation of urban infrastructure was instead contingent on the social legitimacy conferred by the group's middle-class demographic and charitable cause.

Comparing Pedal for Fun's fundraiser with the activities of these Vietnamese sport cyclists and the e-Bikeathon demonstration allows us to more clearly delineate the fundraiser's features, and see how it contributed to the group's re-worlding of the bicycle. Much like MYBYK's Arjit Soni, organisers and participants sought to overcome an existing local worlding of the bicycle as a low-tech, stigmatised artifact, antithetical to the aspirations of India's urban middle classes. Through the Pedal for Fun event, they were able to associate cycling with a community acting in support of a greater good; asserting their class position, as students and young professionals, while negating—at least in part—a long-held stigmatisation of bicycle use. To the extent that the charity ride can be said to have been a success, this turned on its participants' relation to the event's beneficiaries; representing a case where middle-class women took to their bicycles, en masse, to raise money for poor women to train as chauffeurs and taxi drivers.

8.2.c. Women on wheels

By scheduling the charity cycle ride for the Sunday following International Women's Day, and asking participants to wear pink and white (Daily News & Analysis, 2016), the event's organisers were able to link the event with a transnational feminism. This allowed participating cyclists, and Pedal for Fun's members, to assert their modern, 'global' identity. In this way, the fundraiser became part of a feminist worlding, with a common narrative uniting Pedal for Fun's recreational cycling practices with the international push for gender parity. As with other cases of worlding, the organisers' enactments of context allowed the near and far to intermingle, the charity bike ride sharing a common context with other International Women's Day events happening worldwide.

The successful worlding of this relied on a correspondence between the participating cyclists and their beneficiaries. Middle-class cyclists and trainee drivers from

disadvantaged backgrounds represented different social classes, but were united by a common identity as 'women on wheels'; occupying a subject position determined by their gender and mode of transport.[176] In Indian cities, a dominant male street culture forcefully connects masculinity and wage labour, rendering women's presence in the city as an implicit threat to male livelihoods. (Chowdhury, 2018: 198) As a result, many urban Indians link masculinity with mobility, while constructing femininity as static, confined to the interior spaces of the home. (Cresswell and Uteng, 2008: 5) Where the presence of men 'on wheels' would pass unnoticed, this fundraising event and its designated cause asserted women's entitlement to mobility and, by extension, their access to the city.

The fundraiser's beneficiary, Women on Wheels, was launched in Delhi, in 2008, to train disadvantaged women for work as professional drivers, creating stable, sustainable jobs in a career that had been 'systematically denied to women' (Baruah, 2017: 186). Participants undertook 8-10 months of training, including three months of driving instruction, English and customer service skills, gender equality, legal rights, assertiveness, and self-defence. (ibid: 184) Using an hybrid institutional model linking the non-profit Azad Foundation and Sakha Cabs, a for-profit Delhi taxi company, the programme was able to provide stable work through its own radio taxis and placements with private employers. (ibid: 185, 189) With similar programmes since launched in Jaipur, Kolkata, Bangalore, and Indore, the initiative's success in Ahmedabad was boosted by an alignment of supply and demand; as resource-poor women's desire for improved livelihoods coincided with the transport needs of a growing cohort of middle-class, professional women, taking advantage of new employment opportunities. (ibid: 183)

As geographer Melissa Butcher notes, however, the subject position of these newly mobile, urban, middle-class women is circumscribed by risks, embedded in asymmetric power relations, and vulnerable to public rhetorics of moral panic. (Butcher, 2018: 730) Though many women in this cohort have been able to assert a claim to the city, the 2012 Delhi gang rape case, in which a physiotherapy intern was assaulted by six men while travelling in a private bus, has seen male drivers and public transport since cast as a source of risk and possible violence. (Atluri, 2016) Anthropologist Sareeta Amrute argues that, although the Delhi case was exceptionally brutal[177], it was but one episode in an ongoing 'drama of men, women, and class mobility', its details revealing the ever-present

[176] On the gendering of mobility, see Cresswell and Uteng (2008), Sheller (2008).
[177] A factor that attracted high-profile media attention, sparking public protests and sustained pressure for legislative change.

contradictions and gendered fractures in India's story of liberalisation. (Amrute, 2015: 332) With this as their backdrop, navigating the city requires women to engage in continual risk management, including

> when to take the metro, an auto rickshaw, a cab or their own car; when to drive themselves, when to have their own driver, a familiar driver from their local rank, or an unfamiliar driver; what route to take; when to lock the doors; when not to wear jewellery. (Butcher, 2018: 732-733)

As one possible solution to the risk of gendered violence, Amrute cites an interview with a call centre COO, who recalls having 'suggested providing female workers with the technological setup to work at home' (Amrute, 2015: 353). Technocratic and paternalistic, such a proposal would have 'enfolded' women employees in 'patriarchal domestic space', reaffirming a gendered mobility that could further circumscribe their ability to travel. (ibid)

With the figure of the 'isolated and harassed woman riding a rickety commuter bus' contributing to perceptions of the Indian city as a male space (Atluri, 2016: 224), and automobility increasingly embedded in everyday life, the private car has come to serve a shielding function beyond its utility as a form of transport. (Butcher, 2018: 733) For the single, middle-class, middle-aged Delhi women interviewed by Butcher, the car provides a 'protective armature', allowing women to traverse a risky, chaotic public realm while circumventing the dangers of the male gaze. (Butcher, 2019: 802) Sakha Cabs offered a solution to this problem, with the all-woman taxi company able to meet women passengers' need for safe transport.

As part of a wider analysis of the worlding of infrastructure, my account of this charity cycle ride shows how an association with International Women's Day allowed Pedal for Fun to strengthen their re-worlding of the bicycle as a respectable, middle-class technology. At the same time, their beneficiaries at Women on Wheels were re-worlding the automobile, providing poor women with a means to escape the poverty trap, and a less risky transport option for women professionals. Through the charity cycle ride, the diverse scenes of the group's typical activities, the Women on Wheels training programme, and International Women's Day celebrations were able to intermingle, enacted as part of a common picture. (Hastrup, 2013: 149) These associations granted legitimacy to participating cyclists' occupation of public road infrastructure; burnished Pedal for Fun's differential enactment of the bicycle as a modern, respectable, middle-class artifact; and

bolstered the 'defensive distinctions' (Anantharman, 2017) that allowed this new worlding to overcome cycling's stigma and association with the urban poor.

Alongside its mobilisation and use as a symbolic resource, the Women on Wheels training initiative is also instructive in its own right. Much as Pedal for Fun and Arjit Soni attempted to re-world the bicycle, Women on Wheels saw a different group of actors enact a different worlding of the automobile. But where attempts to re-world the bicycle turned on social status and class identity, Women on Wheels and Sakha Cabs focused on questions of gender. These re-worlding efforts straddled the worlds of NGOs and private business, mobilising charitable enterprise and commercial activity to overcome perceptions of the taxi as a male-coded form of transport. Although the company has done little to address the systemic factors reinforcing unequal access to the city's public spaces, the presence of uniformed women drivers in Sakha-branded taxis has challenged gender stereotypes, providing participating women with stable livelihoods, and putting female passengers at ease.

8.2.d. Discussion

In this section, I applied a worlding lens to a meeting between MYBYK founder Arjit Soni and the representative of Pedal for Fun, an Ahmedabad-based recreational cycling group, ahead of an upcoming charity bike ride. Taking this encounter as my starting point, I explored what worlding could bring to an analysis of the construction of the bicycle, in a setting where it had first been encountered as a foreign technology. For Arjit Soni, the bicycle was a utilitarian artifact, enacting entrepreneurial modernity by providing a convenient, flexible solution for the first and last mile of MYBYK customers' daily commute. For Pedal for Fun's membership, by contrast, cycling was first a recreational pursuit, with the bicycle as a platform for sociality and play. As such, this initial meeting and the later Women on Wheels charity cycle ride made it possible to glimpse worldings in-progress, as different actors contributed to different enactments of the bicycle, and sought to manage the resulting tensions, conflict, and non-coherence.

Contrasting Pedal for Fun and MYBYK's respective re-worldings with a local perception of the bicycle as a backward, stigmatised technology, and cases from elsewhere, I showed how India's urban middle classes defended their bicycle use by enacting cycling as a modern, globalised recreational practice. Next, I turned to the charity

cycle ride, an event raising money for Women on Wheels, an initiative training women as commercial drivers. Looking at the connections between the fundraising cyclists and trainee drivers, I reflected on the role of gender in mediating and worlding different mobilities. Finally, I turned to the clients of those trainee drivers, many of whom are also women, members of the professional classes who use a female-staffed taxi company to mitigate the gendered pressures of Indian urban space.

Having used these different enactments of cycling—and driving—to explore the role of worlding in sociotechnical change, the next section extends this worlding lens to an analysis of the built landscapes constituting Ahmedabad's riverfront. At the time of my research, the banks of the Sabarmati river were undergoing rapid change, as part of an urban redevelopment project begun in 2005. Building on my experiences exploring sections of the riverfront on foot, this case connects a worlding approach with those earlier analyses of mutability and mobility, evaluating how these factors have combined to mediate infrastructural development and urban transformation.

8.3. River reflections

Returning to Ahmedabad in the final days of 2015, after eight months back in the UK, the impacts of several slower-moving urban transformations are suddenly apparent; 'before' and 'after' states laid side by side, as if in a cinematic smash cut. As part of the ongoing 'revitalisation' of the walled city's Bhadra Fort precinct, the Sultanate-era citadel is refreshed; its stained masonry now a milky pink.[178] Multi-storey structures shoot upward, shedding their bamboo scaffolding. Most striking, however, is the advance of the Sabarmati Riverfront Development. The scheme's status as of that January, back at the start of my time in the city, had been set as a baseline; details of bare earth and freshly poured concrete relegated to the background.

In these first months, the cleared riverbank became an improvised cricket pitch, the backdrop to a candid photo of some eager local children.[179] Tracing loops through the city after dark, I stumbled across a stretch of the scheme's planned waterfront promenade that initially seemed complete. Upon turning a corner, however, the illusion crumbled; the clean, ordered promises of hard landscaping interrupted by rubble, trenches, and exposed

[178] From field notes, 21 December 2015.
[179] From photographs, 11 March 2015.

wires.[180] But things have moved on. In my eight-month absence, the mounds of dirt on the east bank vanished, broad ribbons of asphalt knitting together, modernist streetlights illuminating newly opened roads and walkways.[181]

Most existing research on the Sabarmati riverfront project has focused on the experiences of the 11,000 families displaced to make way for the development. (cf. Desai, 2012; Mathur, 2012; Salmi, 2019) Where those accounts focus on the scheme's political ecology and failures of distributive justice, in this section, I show how worlding practices allowed the project's architects and middle-class beneficiaries to overcome the multiple obduracies of the existing riverfront landscape. Examining the role of project architect Bimal Patel, and the design and use of recreational spaces like Subhash Riverfront Park, I show how this scheme's worldings reflect a form of urban governance pioneered by Narendra Modi and his allies—highlighting Ahmedabad's role as a laboratory for Hindu nationalist politics. (cf. Chandrani, 2013) Contributing to the study's efforts to show how appropriateness differs from appeals to equity or social justice, these accounts also offer greater purchase on the relationship between normative criteria, perceptions of success and failure, and different actors' enactments of context.

8.3.a. Reconfiguring the Sabarmati riverfront

The Sabarmati riverfront development encompasses 11km of Ahmedabad's waterfront, using material dredged from the riverbed to reclaim 162 hectares of land. Where the river's edge was once porous, its flow varying by season, the development has imposed a 'hard linear edge' (Fenk and Scheffer, 2009: 44), with upper and lower promenades running along both sides of the river. Concrete retaining walls protect the riverbank from erosion. Untreated water and industrial effluents that once emptied into the Sabarmati are now captured by interceptor sewers, running the length of the riverfront, with pumping stations redirecting this wastewater to expanded sewage treatment facilities downstream.

The first proposal to develop the Sabarmati riverfront was made in the 1960s by French-American architect Bernard Kohn. Kohn envisaged an 'ecological valley' encompassing the entire length of the river, to its delta on the Gulf of Khambhat. (Jha,

[180] From photographs, 25 January 2015.
[181] From photograph, 9 March 2016.

2013) In the late 1970s, a second proposal was made possible by the construction of the Dharoi Dam and Vasna Barrage, new barriers created after significant flooding, to better regulate the river's flow. This second proposal stalled following the collapse of Ahmedabad's textile industry, which damaged the city's manufacturing sector and local tax base. After the liberalisation of India's economy in the early 1990s, state and city authorities revisited plans for the revitalisation of the city's waterfront. With the BJP winning state elections in 1995, the AMC established the Sabarmati River Front Development Corporation (SRFDC), a public-private entity tasked with overseeing the development. In 1997, the SRFDC commissioned the Environmental Planning Collaborative (EPC), a non-profit consultancy led by local architect and planner Bimal Patel, to prepare a feasibility study, which proposed the 'comprehensive' development of both banks of the river. (EPC, 1998: 4) Alongside the landscaped promenade, this EPC study envisaged seven new public parks and gardens, the relocation of slum-dwellers, a six-lane road running along the river's eastern bank, and a dedicated space for informal markets. (ibid: 4-6)

Visiting project architect Bimal Patel's office while researching her 2015 book-length study of Ahmedabad, writer Amrita Shah notes an array of models, posters, and computer renders, in which the 'flat, glazed' river

> runs through banks manipulated to create a uniform breadth. ... Concrete walkways with steep staircases run along an eleven-kilometre stretch on either side of the river. Pin-sized figures with elongated shadows dot the grey baked ground. On a second level running alongside the river are manicured lawns and tall buildings. ... The blazing lights from the buildings, the fluorescent green lawns, the cars racing by and sailboats on the billowing sea of water suggest ... the neoliberal project of city marketing. (Shah, 2015: 51-52)

Drawn from the final pages of a chapter introducing the city's history through the lens of the Sabarmati, in this description, Shah identifies Bimal Patel's reconfiguration efforts with the neoliberal worldings of city branding; supplanting one, 'degraded' reality with a world of lawns and concrete walkways. Thereby reconfigured, the riverfront is enacted as an ordered, sterile space, reflecting the city's newfound 'global' status, and Indian bids for 'competitive cultural advantage' and coevalness with the West. (Da Costa, 2015: 84; Fabian, 2014 [1983])

Prominent in local debates around policy, planning, and social inclusion, Bimal Patel was the Sabarmati project's 'most visible spokesperson' (Mathur, 2012: 65), capable of acting with great speed and authority; 'sometimes arguing, sometime mollifying, sometimes throwing his hands up and saying he is bound by orders, sometimes shrugging

and saying you cannot please everybody.' (Shah, 2015: 54) In the course of his conversation with Amrita Shah, Patel cites a 1994 corporate-supported project to redesign a city street as a formative experience, describing, 'with an unwavering gusto', his 'strategies for countering naysayers, sceptics and bad publicity', and surmounting obstacles placed by 'aldermen, politicians, the media, and the public.'[182] (ibid: 53) Shah's unstated implication is that Patel applied similar strategies in managing the Sabarmati project. To justify the redevelopment to an often-sceptical public, he aligned the project with the needs of the city's different populations; promising open spaces and recreation facilities for the urban middle classes, better housing for displaced slum-dwellers, and much-needed improvements to flood management and transport systems. (Mathur, 2012: 65)

In their interactions, Shah notes how Patel avoids talking about his motivations for participating in the project. (Shah, 2015: 54) Appearing, in turn, to 'own and disown the project', he switches from claiming that his 'overriding interest' is 'just that it should get done' to conjuring a utopic vision of a riverfront 'without walls', a public space where 'we agree on adjusting with each other' (Shah, 2015: 54). His invocation of a need to 'adjust' is revealing; a characteristically Indian response to adversity[183], perhaps acknowledging the difficulties in handling the conflicting needs of multiple stakeholders. In any case, these calls for a space of mutual adjustment appear at odds with Patel's comments elsewhere, which saw him blaming the Sabarmati's degraded state on its effective 'privatisation' by those dwelling on its banks. By relying on the river for water and sanitation, and establishing laundry stalls, vegetable farms, and informal commercial spaces on the floodplain, Patel claimed these slum-dwellers had 'disrespected' the river, with their use of the space contributing to its low water level. (Mathur, 2012: 66) The SRFDC provided Patel with a way to 'return the river to the public'—albeit a narrowly-defined public, identified with the city's middle classes. (ibid.) But this project did not require adjustment on the part of its planners or architects, with concessions to better accommodate the space's existing users. Instead, the reconfigured riverfront was imagined as a landscape in

[182] In these accounts, Bimal Patel is cast in the role of a system builder, manipulating heterogeneous social and technical elements to help realise and sustain a coherent sociotechnical ensemble. (cf. Van der Vleuten, 2004; Jackson et al., 2007) One of several 'prominent architectural entrepreneurs' active in Ahmedabad at this time, his work involved juggling allies and interests from across local government, educational institutions, heritage organisations, architecture practices, and the creative and cultural industries. (Da Costa, 2015: 84)

[183] Signalling a need for metal recalibration or a downgrading of expectations, requests to 'kindly adjust' or 'adjust a little bit' are often associated with infrastructure problems, bottlenecks, or delays—in short, situations where someone might see cause to make light of an unfortunate situation. (Dyson, 2017: 274-275)

which a collective public 'we' would accede to adjust 'with each other' (Shah, 2015: 54), and in doing so, prevent the space from being appropriated by any single group.

Those convinced by Patel's description of the reconfigured riverfront as a space of mutual adjustment might have imagined a landscape with certain features; mutable and flexible, supporting the varied practices of a range of possible users, without exclusion, such a redevelopment could have retained elements of the existing landscape. It might, for example, have set aside space for the continued trading of the weekly Ravivari-Gujari bazaar (Lauer, 2016), much as the Janmarg Bus Rapid Transit project had flexed to retain temples, monuments, and the occasional electricity pylon.[184] The resulting landscape could have supported multiple different practices. With no clear, invariable rules to structure relations between different enactments of the space, planners would have had to rely on their judgement, proceeding through tinkering, experimentation, and 'gentle negotiation', while remaining mindful of the 'materials at hand' (Law et al., 2013: 182). Paralleling calls to 'kindly adjust', as above, different users would be asked to—temporarily—reconcile their differences, and find ways to keep their needs in balance. (ibid: 188-189)

As the Sabarmati development progressed, its planners and proponents did, at times, acknowledge the multiple enactments of the riverfront landscape; making visible efforts to handle the resulting non-coherence. Following protests and the filing of public interest litigation with the High Court of Gujarat, the Ravivari-Gujari bazaar's incongruity with the wider riverfront development was mitigated by taming its differences, shaping it into something that cohered. (Mathur, 2012: 70-73; Law et al., 2013: 180) Relocated to a nexus of tourist activity, and signposted as a 'Riverfront Market', SRDFC planners re-worlded the institution as a spectacle of authentic local culture; a historic remnant embedded within the riverfront's modernist landscaping. (Lauer, 2016: 53) As a second case, the development also featured a 'state-of-the-art' laundry campus, on the eastern bank, and at some distance downstream.[185] By recognising those who had traditionally used the Sabarmati's banks to wash and dry clothes, but relocating these practices, the project's planners held difference at bay, separating utilitarian and livelihood practices from the riverfront's desired middle-class visitor base. (Law et al., 2013: 181)

Beyond these limited concessions to difference, the riverfront's programming and reconfigured layout refused to recognise that which did not fit. (Law et al., 2013: 189-190) Bimal Patel's promotion of the riverfront as a space of mutual adjustment was belied by

[184] See pp. 140–142.
[185] From Sabarmati Riverfront website. <www.sabarmatiriverfront.com/project/laundry-campus>

the SRFDC's problematisation of the riverfront's slum-dwellers; a larger, less tractable source of difference, who were uprooted and excluded from the reconfigured space. Moralised as having disrespected the river through pollution and overuse (Mathur, 2012: 66, 73), these slum-dwellers were cast as illegitimate users of the riverfront, incompatible with the recreational practices of those depicted in Patel's models, plans, and computer renders. (Shah, 2015: 51-52)

Elsewhere in India, large, top-down urban development projects have been contested by groups of poor or subaltern city-dwellers, who parlay their electoral influence for access to services and the formalisation of *de facto* land tenure claims. (cf. Benjamin, 2008) This has resulted in urban development patterns shaped more by overlapping land claims and the threat of opposition than any 'overarching objectives of state modernism or corporate-driven commodification.' (Shatkin, 2017: 89) Paralleling the urban grand plans profiled in Chapter 3, the SRFDC responded to this threat of non-coherence by ejecting those the scheme dispossessed, who were banished to spaces far from the waterfront. [186] By making plans to resettle this population, the project's planners portrayed themselves as bringing order and progress to the riverfront space[187]; a pure and totalising vision 'articulated at the level of service to humanity.' (Mathur, 2012: 67)

Since the early 1990s, subsequent Indian governments have worked to unpick obstacles to the commodification of land. In practice, this has seen attempts to increase state control over urban land markets, borrowing strategies and policies from China and Singapore to insulate land managers from contestation. (Shatkin, 2017: 100) Operating independently of municipal and state governments, the SRFDC is one of many parastatal, development-specific entities created to shield urban projects from public participation and occupancy claims. (ibid.) Although such strategies often risk opening new arenas of conflict and resistance, in Ahmedabad, at least, no protests materialised, and the SRFDC's denial and expulsion of difference passed with muted opposition. With little support for criticism or resistance to the project among Ahmedabad's middle classes, those best placed to contest the Sabarmati project were, in this case, those most likely to avail

[186] In her interactions with Bimal Patel, Amrita Shah name-drops Robert A. Caro's 'monumental' biography of Robert Moses; 'the man lionized for his visionary plans to develop New York until people counted the costs' (Shah, 2015: 54). Left implicit, in her telling, is the parallel between Moses' redevelopment efforts—reshaping New York in a way that prioritised the needs of the automobile and the rich—and Patel's Sabarmati project, a top-down scheme enabled by 'totalitarian' governance. (cf. Mathur, 2012)

[187] On denigration and uplift as rhetorics of colonial discourse, see p. 93.

themselves of the development's parks, recreational spaces, and infrastructural improvements.

Ultimately, any existing uses of the riverfront landscape were crushed by a 'barrage of colourful propaganda' congruent with Shah's description of the renders and models seen in Bimal Patel's office—a 'million microcosms' unmade by those enacting the banks of the Sabarmati as a blank slate open to development and capital accumulation.[188] (Mathur, 2012: 74; Shatkin, 2017: 149) Focusing on Patel and his colleagues' enactments of the riverfront, the following sections examine how worlding has been inscribed in details of the development's landscaping and built environment. I share my observations traversing the Sabarmati development's public spaces and promenades, and interface ethnography of a public event celebrating of the river in one of the scheme's feted parks.[189] Connecting this analysis with physical traces of worlding in the urban landscape, I then examine, in turn, restrictions on access to the riverfront's parks, real estate hoardings, an amphitheatre, and the development's 'European-style' promenades. I conclude by showing how each of these elements are implicated in SRFDC's worldings and enactments of context.

8.3.b. Reflecting on the River

In my second phase of fieldwork, I fall into the habit of eating a couple of times a week at a vegan restaurant run by a Spanish expat, in a retail complex to the west of the city.[190] One evening, I hear a familiar voice at a table behind me; a lecturer in landscape architecture at a UK university, who I met on a heritage walk during a pilot visit to the city, two years earlier, in January 2014. Wary of interrupting, I reach out over email the following day. Her and a colleague are working with partners at Ahmedabad's CEPT University, on a project about rivers and rapid urbanisation.[191] They invite me to a seminar at CEPT, followed by 'Reflecting on the River', an evening event at Subhash riverfront park. Unable to attend the seminar[192], but keen to make the accompanying event, I catch an auto-rickshaw over the river and through an unfamiliar part of Ahmedabad, far enough

[188] On denigration and negation as rhetorics of colonial discourse, see p. 93.
[189] Part of a UK-Indian university research project on the changing role of rivers in urbanising India.
[190] From field notes, 15–19 March 2016.
[191] Research supported by national funding bodies in India and the UK.
[192] The lecturer and her colleague later concede that the seminar attracted fewer attendees than they had hoped, clashing with both a high-profile India-Pakistan cricket match, and an intramural university volleyball tournament; from field notes, 20 March 2016.

north to leave the walled city for a series of property developments under construction. In the thickening twilight, we pass a hospital, a Reliance-branded big-box superstore, and a Muslim cemetery. A man on a bicycle hauls a labelled box of lithium-ion batteries.

The park is just over a kilometre in length, stretching from Subhash Bridge in the north to Rishi Dadhichi Bridge in the south. The auto driver drops me at a turning before the former. Following the road down to the park, I pass vacant lots and the skeletons of incomplete high-rises, a prefab site office screened by hoardings for the development in-progress, Sheetal Aqua. Hollow slogans and flawless computer renders promise 'luxury' three- and four-bedroom apartments overlooking the river. '*A Precious Thing, The Right Place*.'

The first set of park gates are locked. A guard directs me to a ticket booth, where I hand over a ten rupee note, the cost of admission. Now dark, it is cool enough to comfortably sit outside. The park's lights are softened by a sour hydrocarbon haze, lingering from earlier in the day. The cropped grass, pale concrete, and lines of trees are consistent with the rest of the redevelopment, familiar from the profile pictures and social media posts of local contacts photographed visiting a kite festival or flower show. I take a seat in the crowded amphitheatre, a stepped semi-circle alternating lines of stone and turf. The audience is mixed, including parents with their children, Muslim families, and a group of younger men, joking and roughhousing in the back rows.

As I find a place to sit, rucksack at my feet, a smartly dressed artist attacks a six-foot canvas with a roller dripping thick, sky-blue paint. Flanked by three male students, with his shirt sleeves rolled up, his brushstrokes respond to the movement and gestures of a classical dancer at the front of the stage. A technician sits with audience members in the front row. Headphones round his neck, he tinkers with amplifiers, lighting controls, and a tower of flight case electronics. Later, a man in a blue vest introduces a presenter from online radio station GujaratiRadio.com, and a dancer balances a flaming earthen pot atop her head, as she navigates an unforgiving cross-breeze. As a team of local radio DJs pick their way through an extended spoken word performance, my attention turns to the far bank of the river. Beyond the event staging and the concrete riverfront wall, and across the water, powerful floodlights illuminate the middle storeys of an unfinished building; another beneficiary of the riverfront project's looming completion.

Constituting a space where researchers and performers 'interfaced' with a wider public, this 'Reflecting on the River' event was both urban spectacle and a strategic site for observational research. (cf. Ortner, 2010) Remaining conscious of the event's intended audience, I focus in on three elements from the above scene: (1) the park's scripting and layout, illuminated by the imposition of gates and an entrance fee; (2) the visible presence of construction work and property hoardings; and (3) the park's amphitheatre, indexing an expectation of regular performances and cultural events. Taking each of these details in turn, I demonstrate how they register the practical ontologies and material impacts of Patel and his fellow planners' re-worlding of the Sabarmati riverfront.

8.3.c. Gated space

Among the first completed sections of the Sabarmati riverfront development, Subhash Riverfront Park opened to the public in October 2013. Referencing the design of Gandhi's Sabarmati Ashram, which it faces across the river[193], the park serves the adjacent Shahibaug and Dudheshwar neighbourhoods, which previously had limited access to green space. This riverfront park diverges from Ahmedabad's other parks, however, in the details of its landscaping and layout. During my time in Ahmedabad, when at a loose end or hitting dead ends in my research, I often lingered in Law Garden[194] and the Italianate Parimal Garden, garden parks serving middle class neighbourhoods in the west of the city. Where these spaces were frequented by those who live or work nearby, Subhash Riverfront Park was laid out as an attraction for an 'desired pedestrian.' (Thomas, 2016) Traces of this imagined pedestrian can be seen in the prevalence of paved surfaces, low shrubs, and verdant, well-tended lawns. In the city's other parks, banana, peepal and gulmohar trees provide respite from the city's semi-arid climate, mitigate pollution, and break up the urban heat island, while offering a habitat for birds and animals, and privacy for human visitors. On the riverfront, however, dense tree planting would have impeded visitors' panoramic views of the river; a vista planned as a spectacle to be consumed. (Thomas, 2016: 54)

Ahmedabad's other parks are open from dawn until dusk[195], their multiple entrances allowing free, unimpeded public access. Subhash Riverfront Park, by contrast, charges a

[193] On Gandhi's ashram as an engine of social and political change, see Chapter 4; pp. 59-60.
[194] Named for its proximity to the city's courts and legal colleges.
[195] Though usually closing for two hours over lunchtime.

10-rupee entrance fee.[196] Priced low enough to be accepted by most visitors, the fee differentiates the park from most of the city's other green spaces. The closest parallel is the Kankaria lakefront, a fifteenth-century artificial lake providing water for the nearby royal palaces, redeveloped by the AMC in 2008 as a tourist attraction, with a zoo, amusement park, motorboats, and a tethered hot-air balloon ride. (Sharma, 2013; Shah, 2014; Salmi, 2019: 398-399) In Kankaria and Subhash Park, ticketed entry has turned once-public spaces, supporting multiple uses, into destinations scripted for leisure and recreation. The park's introduction of ticketed entry did not, however, pass without controversy. Following protest and lobbying by morning walkers and senior citizens, access to the riverfront park was made free between 6am and 8am. (Sharma, 2013; Dasgupta, 2018) Members of these groups head to the city's parks from dawn, staying out for a couple of hours, while walking, jogging, and engaging in light exercise. Elsewhere in the city, green spaces bear the material traces of adjustments made to accommodate these visitors, including public exercise equipment, noticeboards for walking clubs, and organised yoga classes.

By enforcing entrance rules that differentiated users based on time of entry, these joggers and walkers were unlikely to encounter the tourists and middle-class pedestrians targeted by the project's developers. Responding to the threat of non-coherence with on a logic of separation, the Sabarmati development's planners conceded a limited space for 'minor practices' (Law et al., 2013: 189). Where the same planners had used spatial separation to relocate customary laundry-washing practices to a dedicated facility downstream, seniors and morning exercisers were accommodated through a temporal division. Creating an exception to the park's restrictions on entry during the early morning, the SRFDC made sure that the park's different users and their activities would not overlap. (ibid: 180-181)

The imposition of ticketed access to sections of the riverfront, taken alongside select, time-limited exceptions, are emblematic of a process of middle-class capture—in which the city's middle classes, operating within the strictures of neoliberal urbanism, are able to 'physically capture or usurp public space' (Mehta, 2018: 20). Other examples of this dynamic include the *Happy Streets Ahmedabad* campaign[197] (Mehta, 2016), the Women on Wheels charity bike ride, and the proliferation of private, gated communities elsewhere in the city. In each case, middle-class capture follows a desire to realise globally prevalent

[196] With subsidised tickets available for children and school parties.
[197] For more on the *Happy Streets Ahmedabad* campaign, see Chapter 6; p. 119.

images and discourses of 'good urban life' (Mehta, 2018: 21). Following the 2001 pogrom, in Ahmedabad, these aspirations have been further mediated by anxieties about wounded Gujarati pride, and a sense of class-based vulnerability derived from fears of being outnumbered by a poor, low-caste majority.

8.3.d. Real estate

Although the Sabarmati development was most frequently presented as an infrastructure project, for many of its advocates, the scheme's contributions to the city's roads, greywater infrastructure, and green space were purely instrumental. Their goal was to maximise Ahmedabad's real estate potential, raising land values and creating opportunities for property development in the city centre. (Mathur, 2012: 67) Recognising the riverfront development as one local iteration of a widely replicated 'spatial strategy and product', architect and urbanist Himanshu Burte describes how the production of real estate, paired with 'bold claims' of the scheme's public benefits, served to lure foreign investment capital to Ahmedabad. (Burte, 2016: 62) On the riverfront, this relied on a 'figurative displacement' of the original Sabarmati, with a 'pinching' of the existing water course producing a 'long, artificial, open-ended tank' occupying the same location. (ibid: 68) By adjusting the 'natural slope of the river's edge', and installing concrete retaining walls, the project's engineers were able to produce new, usable real estate in the heart of the city. (ibid: 66-67)

The key feature was usability. Where the unimproved river had been a densely networked space 'connecting natural processes, informal social activities, and meanings' (Burte, 2016: 68), the Sabarmati riverfront development severed many of these existing ties. If the river had previously been one actor in a larger socio-ecological system, its replacement was a 'sort of aqueous spatial product', configured for capital accumulation. (Burte, 2016: 70) Expert-led abstraction saw ecological complexity supplanted by a simple, concrete vertical plane; an 'oversimplified physical embodiment' of engineers' imaginings of the 'partition between land and water' (ibid: 69). In ontological and material terms, one reality replaced another, a complex relational landscape reworked, by the SRDFC, as inert plots suitable for development.

Tracking this reconfiguration of the riverfront, the Sheetal Aqua hoardings outside Subhash Riverfront Park signalled the dual role of urban property, as a vector of capital

accumulation and locus for place-making and identity formation. (De Neve and Donner, 2015: 258) In a 2011 *Mint* article on the disjuncture between real estate projects spurred by the Sabarmati development and the uncertain fates of those it displaced, journalist Maulik Pathak describes how developers saw the project, first, as a business opportunity:

> "The riverfront saga begins..." blares the slogan on a billboard that came up recently near the campus of the Indian Institute of Management, Ahmedabad (IIM-A), in the Vastrapur neighbourhood. Posters showing dolphins diving in and out of the water and water sports being played are being displayed as part of a campaign by Ahmedabad-based development JP Infrastructure Pvt. Ltd to promote its first residential project on the riverfront. (Pathak, 2011)

Scrolling, later, through PDFs of promotional material for the Sheetal Aqua development, bombastic rhetoric promised proximity to the 'phantasmagoric and iconic Sabarmati Riverfront', and the promise of 'enjoying a simple cup of coffee gazing out to Ahmedabad's signature water view.'[198] In this, an invocation of the river as a spatial context diffused a concern that the Sheetal Aqua project might, like so many other developments, otherwise appear decontextualized; detached from prevailing local socio-political conditions. (cf. Aalbers, 2020; Savini and Aalbers, 2016)

Much as my analysis of differential enactments of the bicycle had to show 'historical thickness' (Fan, 2016: 365), accommodating a colonial history characterised by acute power asymmetries and structural violence, any analysis of the commoditisation of land, and the results of such, has to be similarly torqued. The Sabarmati riverfront project, like other such developments, has been shaped by the interplay of global hierarchies, local dynamics, and specific historic legacies. Demonstrating parallels with recent work on urban development in Warsaw (Büdenbender and Aalbers, 2019), the AMC and SRFDC had to negotiate the financialisation of the riverfront from a subordinate position, as a secondary Indian city on the periphery of the global economy, with less latitude to depart from investors' expectations.

Responding to their peripheral positioning, the Sabarmati development's planners and architects made frequent reference to the 'world-class' waterfronts of Paris, San Francisco, Chicago, and London. (Mathur, 2012; Umarji, 2017) Later, developers building on land reclaimed from the riverbed invoked similar worldings to justify their projects' use and exchange values to would-be buyers. For both groups, a given project's 'world-class' character became an assertion of coevalness, connecting their developments with the promissory trappings of development and a global modernity, while disavowing a

[198] From Sheetal Infrastructure website. <sheetalinfra.com/portfolio/sheetal-aqua-shahibaug>

residual 'old' India, out of sync with the wider world. (cf. Kaur, 2012: 604, 617) For its re-worldings of the riverfront landscape to hold, the Sabarmati development had to modulate an unusual double tension; appearing sufficiently distinctive to differentiate Ahmedabad from other Indian cities, while emulating features seen as integral to the success of the 'world-class' waterfront developments its planners hoped to replicate.

As one example of an attempt to resolve this tension, the Sabarmati project prompted the AMC to introduce new volumetric development guidelines, allowing the SRFDC to sell development rights based on volume instead of area. Drafted to support construction of the kind of iconic, high-rise skylines seen elsewhere, these regulations permitted developments of up to 22 storeys on plots closest to the river (Umarji, 2014), a change benefitting the Sheetal Aqua project, among others. This example shows how the reconfigured waterfront's use and exchange value derived, in part, from the development's production of an 'iconic' spectacle. Among the project's supporters, it was hoped that a modern, recognisable skyline would be able to arrest the gaze of the city's aspiring middle classes, and appeal to investors drawn from a transnational—often diasporic Gujarati—elite.[199]

8.3.e. Performance and public spectacle

Just as ticketed access and the presence of construction activity reveal Subhash Park's implication in processes of financialisation (Aalbers, 2020) and middle-class capture (Mehta, 2018), these also shaped the form and programming of the 'Reflecting on the River' event. Planned and promoted as a celebration of artistic interpretations of the Sabarmati, the evening event encompassed poetry and spoken word performances, live painting, theatre, music, and dance—but a more salient detail lay in the park's stepped amphitheatre. A permanent feature, this amphitheatre's structuring of space again reflected the influence of planners' desired pedestrian, appearing, in this case, as a spectator and audience member. (cf. Thomas, 2016) Where the stages and performances of the *Happy Streets Ahmedabad* campaign had been temporary, supporting participants time-limited appropriation of road space for recreation, the park's amphitheatre institutionalised and concretised these same practices. In the amphitheatre's material

[199] As Ravinder Kaur and Thomas Blom Hansen attest, 'the spectacle of India's transformation into an investment destination is such that its ultimate success lies in inviting the participation of those who look at it desirously from afar—investors, tourists and global capitalists—to come and invest in the India Story.' (Kaur and Hansen, 2015: 269)

obduracy, the park's designers had anticipated precisely these kinds of events, occurring with sufficient frequency to justify the investment in hard landscaping, and foreclosure of other uses of the space.

The evening's performances also offer an example of the use of culture and creative production to 'revalorise' urban spaces perceived to have been degraded through neglect or misuse. (Da Costa, 2015: 74-75) On the riverfront, this manifested as a celebration of Gujarati culture, spanning forms and genres, but appealing to a popular audience. For Dia Da Costa, equivalent processes were exemplified in Ahmedabad's 2013 Cotton Exchange Exhibition, an art show organised in one of the city's disused textile mills. For Da Costa, the tone and programming of that show demonstrated how the creative sector's 'civil optimism' could happily coexist with India's often 'brutal' conjuncture of cultural nationalism and neoliberal capitalism. (Da Costa, 2015: 75-76)

From my own stay in the *pols*, I think of 'Street Beats', an amateur photography exhibition celebrating life in Ahmedabad's walled city, taking place amid the debris of a house that had recently collapsed, following years of neglect.[200] At the time, I was struck by the choice to use one of the building's surviving doorframes to anchor a cable supporting the display boards; the images' romanticised subjects and sentimental gloss appearing, to me, starkly at odds with their setting. This incongruity seemed to pass unnoticed by the events attendees, however, for whom the depicted subjects had greater salience than the mess and chaos of the exhibition's surroundings. In this exhibition, as at the evening event at Subhash riverfront park, a 'sentimental capitalism' co-opted cultural production to revalorise neglected or degraded spaces. (Da Costa, 20215) Displacing the city's charged histories of violence and exploitation, nostalgic discourses and creative practice scaffolded situated, locally rooted urban transformations, contributing to the reconfiguration of space. (Da Costa, 2015: 77, 85, 91) In Subhash riverfront park, the amphitheatre facilitated cultural enactments of context; a material feature which tracked the SRDFC's opening of the riverfront to commoditisation and development.

[200] The *haveli*'s owner, Rajiv, explained that the Hindu religious organisation who owned the structure had little interest in rebuilding, and were instead focusing their energies and resources on a new temple, in the west of the city, catering to a wealthier class of donors and devotees; from field notes, 30 May 2015.

8.3.f. On the waterfront

At the park, it is growing late. As the audience thins out, and people begin to make their way home, I drift through an open gate and down some steps, hoping to get a better sense of how the park fits within the larger redevelopment.[201] On the lower promenade, close to the river, a young couple find privacy in the shadows between trees, while, anticipating a looming 10pm closure, a guard waves me away from the water. Taking a larger gateway, I cross some grass, and climb a set of steps back up to the four-lane, north-south highway. Despite the late hour, there are still people out and about; three men wait in a parked van, its interior lights on, as families walk back to the city centre. A man shits behind a wall, shielded from the lights of passing cars and auto-rickshaws. A motorcyclist stands by his bike, looking out over the river.

Cast into this unfinished landscape, a strip of bare dirt between the highway and the lower-level riverfront promenade, I feel vulnerable. The pavement is still new, the river somewhere to my right, hidden in the darkness. Approaching Gandhi Bridge, it initially seems like the walkway might intersect with the cross-cutting road, providing a way up onto the river crossing, and back into the city centre. But as I draw closer, the two paths remain stubbornly disconnected. Dropping beneath the road, narrow steps deliver me to a void beneath the bridgehead, a truncated tunnel open to the night air. Stopping to take in my surroundings, my eyes come to rest on the fruit bats roosting overhead.

Contrasting my experience of the Sabarmati development's splintered, incomplete edges with evidence of its mobilisation as a stage for public spectacle, the gap between these descriptions highlights how the city's waterfront has become another performative space. Yet another case of disconcertment, the sensory, embodied impact of the difference between the development's messy, incomplete edges and its gated parks and promenades provide an opportunity to scrutinise the scheme's more 'fetish-like' dimensions. (Larkin, 2013: 329) With many projects standing as material emblems of modernity and state power (Namba, 2017: 79), many researchers have written on how infrastructure has come to signify both the utility's use value and the 'promise of participating in [a] … new world of technological advancement and 'progress'' (Kaika and Swyngedouw, 2000: 124).

Infrastructural fetishism has been largely dismissed as a product of naivety or a lack of sophistication on the part of those, who, in ascribing immaterial power to infrastructure

[201] From field notes, 19 March 2016.

projects, muddle cause and effect. (Pietz, 1985; 1987) Typically appearing in intercultural contact zones during periods of upheaval (Pratt, 2008), fetishism is not just a case of simple naivety or magical thinking, but, instead, a creative attempt to reconcile radically different systems of value.[202] (Pietz, 1985: 7; Namba, 2017: 79) In the case of infrastructure, attributions of agency or 'ordering power' (Pietz, 1985: 7) index the sociotechnical transformations unleashed by systems facilitating connection and material flows. This is particularly evident in the global south, where a given network's utility might be overshadowed by its status as a material emblem of modernisation or development.

In her research on urban development in Vientiane, Laos, ahead of its hosting of the 2008 ASEAN summit, Miki Namba describes how projects western-trained experts had derided as 'empty' nonetheless attracted 'investment and interest, … even appear[ing] to propel Laos into modernity.' (Namba, 2017: 82) Development and infrastructure projects discounted as dysfunctional fetishes can contribute to urban transformation, even as they depart from normative benchmarks of the modern ideal. In Ahmedabad, as in Vientiane, given projects' extra-technical, fetish-like aspects have played a key role in enrolling allies, support, and investment—and through this, surmounting the obduracies and intractabilities of the existing city. To make this case, I turn to the Sabarmati development's riverside promenades. Connecting the development's fetish-like aspects (Larkin, 2013) with its enactments of context (Tsing, 2010: 49), the SFRFDC's labelling of the riverfront paths as 'promenades'[203] presents a puzzle and problem; reproducing a spatial form that appears, at once, oddly antiquated and culturally foreign.

Historian William H. Seward Jr. traces the origins of the promenade to pre-revolutionary Paris, and the Cours-la-Reine; a mile-long strip of land on the north bank of the Seine, established by the Queen of France in 1628. Enclosed by iron fencing and with royal guards posted at the gates, the space was an exclusive meeting point for the French aristocracy, a place to see and be seen. (Sewell, 2014: 19) From this origin, the promenade tracked the rise of urban leisure and consumption, and eclipse of traditional elite culture. (Borsay, 1986: 131; Sewell, 2014: 16) Opened to a wider popular public, the promenade allowed walkers to circumvent the city's overcrowded and unpaved streets. (Turcot, 2015: 69) Some spaces hosted events, providing an attractive backdrop for magic lantern shows,

[202] The concept originated on the coast of West Africa, in the 16th-17th centuries, a contact zone for Christian feudal, African lineage, and merchant capitalist systems, where it denoted objects invested with their own, autonomous agency. (Pietz, 1985: 6–7)
[203] See Sabarmati Riverfront website. <http://sabarmatiriverfront.com/river-promenade>

concerts, firework displays, and flights in hydrogen-filled balloons. (Park, 2018: 32-33) But having traced the promenade's origins to seventeenth-century Paris, a setting far removed from mid-2010s Ahmedabad, the relationship between these original European promenades and those reproduced in the Sabarmati development poses questions about fidelity and mimesis; with the latter representing a combination of self-conscious mimicry and aesthetic governance.

Postcolonial theorists such as Homi Bhabha (1994: 85-92) have used mimicry to describe how colonial subjects adopt and adapt to the culture of a colonising power, through an 'exaggerated copying of language, culture, manners, and ideas' (Huddart, 2016: 39). Discussing the production of 'mimetic space', researcher Moriel Ram cites the case of Mount Hermon, an Israeli-occupied territory which state-backed developers have turned into an 'ordinary', western-style ski resort, emulating the appearance of the Swiss Alps. (Ram, 2013) Configuring this landscape as mimetic space, Israel used the familiarity of the tourist resort to transform a peripheral, politically charged site into an attractive, foreign-seeming destination; and, in doing so, render it as an 'integral part of the state.' (Ram, 2013: 737)

In Ahmedabad, as on Mount Hermon, the emulation of an established spatial form helped negate the presence of an existing population. The construction of European-style riverfront promenades appears as justification for the displacement of riverbank slum-dwellers; furthering a re-worlding the waterfront as a blank slate for financialisation and development. Rather than reading Ahmedabad's urban and infrastructural reconfigurations as naïve colonial mimicry, 'primitive' fetishism, or the lateral, point-to-point transfer of a stabilised immutable mobile, the Sabarmati project's promenades might, instead, reflect a deliberate strategy of the development's architects and planners. Blending rationality and fantasy, desire and expert knowledge, these planners erased prior enactments of the riverfront space, while naturalising the displacements, middle-class capture (Mehta, 2018), and active practices of separation and exclusion that facilitated their visions of urban reconfiguration.

Identified with a seemingly single-minded pursuit of 'world-class' stature by policymakers, politicians, and business actors, geographer Asher Ghertner coined 'rule by aesthetics' (Ghertner, 2015) to name a force he saw structuring the modernisation of Delhi during the run-up to the 2010 Commonwealth Games.[204] At this time, as he explains:

[204] Something showing distinct parallels with Miki Namba's account of the reconfiguration of Vientiane in the run-up to that 2004 ASEAN Summit. (Namba, 2017)

> Skyrocketing land prices, hubristic government proclamations of the glorious city yet to come, and carefully crafted image work by real estate firms, the media, and international consultants gave further impetus to … the decades old promise of making Delhi look like Paris—of transforming this old Mughal city into a globally competitive, aesthetically appealing metropolis (Ghertner, 2015: 184).

Embraced as a normative benchmark guiding policy, infrastructure, and urban reconfiguration, invocations of the 'global' and the 'world-class' show how visual and sensory experience has become a form of governance. In the guise of the 'world-class city', a push for infrastructure development and urban transformation becomes a stated desire to realise 'globally indexed targets of development' (Ghertner, 2015: 8). Lacking any rigorous or replicable way to evaluate progress toward such a goal, practices of aesthetic judgement are used to partition 'the beautiful from the ugly, that which belongs from that which does not' (ibid: 17).

Distinct from best practice 'solutions' stabilised as immutable mobiles and 'fast policy' (Peck and Theodore, 2015), the power of the 'world-class' city comes from its sensory impact; something evident in the 'excitement of stepping into an air-conditioned, stainless steel carriage on the Delhi Metro, on the pride of living near a shopping mall with more marble than the Taj Mahal' (Ghertner, 2015: 9). At the same time, those elements of the present judged insufficiently 'world-class', such as the slum, are stigmatised as backwards, anachronistic, a residual source of disorder—or else sanitised as heritage, a fixing or arrestation of some 'local', idealised past. To be world-class, in short, is to appear new, while catering to the needs, taste, and aspirations of those wealthy, urban subjects seen to be propelling modernisation and development.

Practical ontologies of aesthetic governance can be clearly identified in the *Swachh Bharat Abhiyan* ('Clean India Mission'), a central government initiative launched in October 2014, which aimed to eliminate open defecation and manual scavenging. (cf. Jeffrey, 2015; Doron, 2016) Although most of the scheme's funding was earmarked for rural toilet-building, a city-focused component, operating under India's Ministry of Housing and Urban Affairs, funded public information campaigns targeting the challenge of 'urban filth'. (Luthra, 2018) Driven by the growing influence of expanding consumer and 'neo-middle' classes[205], and these groups' yearnings to be 'free of the slur, often expressed by others, that 'India is a dirty place'' (Jeffrey, 2015: 816), the Mission sought to

[205] The latter group encompasses the more economically successful of the lower classes and backward castes, assuming a common subject position as aspiring beneficiaries of a decade of economic growth; something particularly well-represented in Ahmedabad and Gujarat. (Jaffrelot, 2013; 2016)

foster a 'spirit of volunteerism' and 'civic duty towards public hygiene' (Luthra, 2018: 123).

With *Swachh Bharat*'s messaging filtering into everyday practice, anthropologist Assa Doron describes how groups of young people, mostly men, have begun acting as self-appointed 'sanitation squads', cleaning up their cities. (Doron, 2016: 717) Comparable initiatives in Bengaluru, Delhi, and Bhopal have received favourable media coverage. (cf. Singh, 2016; Tripathi, 2017; Rajappa, 2017; Sharma, 2017) Coordinating with local authorities, volunteers engage in 'spot-fixing', identifying dirty urban 'black spots', and addressing identified issues by picking litter, fixing potholes, installing CCTV cameras, adding benches, and painting dirty walls. (Rajappa, 2017) Pushed as to participants' motivation, a founding member of one Bengaluru group described spot-fixing as 'sort of an addiction', with a sensory appreciation of the contrast between 'before' and 'after' driving further interventions. (ibid.) Shared online, these groups' photos have become a site for enacting a 'particular teleology of urban aesthetic transformation' (Luthra, 2018: 127), and directing attention to how a given area has changed or progressed. (Doron, 2016: 733).

Practices of spot-fixing betray a middle-class bias in participants' understandings of how public space should appear, enacting a 'moral critique of the dysfunctional nature of Indian society' fuelled by the desire to 'transform India's messy urban landscapes in line with world-class standards.' (Doron, 2016: 717, 727) Such interventions reaffirm a hierarchy of value, modelling India's future on post-colonial spaces like Singapore, and the well-ordered cities of an imagined West. (Doron, 2016: 731) At a quotidian level, the desire for 'world-class' status relies on urban Indians' comparisons, contrasting their own urban spaces with those of the developed world (Luthra, 2018: 128)—particularly those visited by middle-class Indian professionals or inhabited by members of the overseas diaspora. Aspirations to the clean, modern city parallel colonial and postcolonial narratives of hygiene as a 'cultural' issue, problematising inhabitants of the 'old' India, whose 'hygienic practices need to be disciplined in order to become modern.' (Libid: 126)

Comparing the Sabarmati development—and its promenades—to the *Swachh Bharat* Mission, the riverfront project shows clear similarities with the 'spot-fixing' practices of those urban volunteers. Straying from the development's gated parks and gardens to walk the riverfront promenade, after dark, the striking sensory impact emerged in the gap between the informal practices and relational landscapes of the urban

poor, and the aesthetic preferences of the city's middle classes and young professionals. The pre-existing, mixed-use riverfront, which supported the dwellings and livelihoods of poor, marginalised urban citizens, has been supplanted by a city-scale reproduction of the models and computer renders observed in the office of lead project architect, Bimal Patel. (Shah, 2015: 51-52) Catering to the preferences of a newly influential, young, urban middle class, the development closely paralleled spot-fixers' transformational 'before' and 'after' shots. As one world replaced another, this rationalised riverfront and its clearly scripted spaces became a vehicle for modernisation, invested with the exceptional capacity to bring order to an otherwise chaotic, messy space.

8.3.g. Discussion

In this second case, I applied a worlding lens to Ahmedabad's Sabarmati riverfront development, a scheme that wrested control of the city's waterfront from urban slum-dwellers and informal workers, reconfiguring it as a leisure space suited for use by the city's increasingly assertive middle and 'neo-middle' classes. Sharing my experience of 'Reflecting on the River', a cultural event hosted at Subhash Park, and the development's riverfront promenades, I examined a number of details from the development, points of interest registering the presence and material effects of worlding in the development's planning, implementation, and use. I traced how gates and ticket booths, property development hoardings, an amphitheatre, and European-style promenades contributed to a single-minded pursuit of 'world-class' status, dependent on 'othering', denial, and the separation of difference. (Law et al., 2013)

In the reconfigurations of millennial Delhi, Asher Ghertner saw evidence of a 'new extroversion', indexing the city's future to the present of other global cities. (Ghertner, 2015: 9) On the banks of the Sabarmati, I encountered a similar phenomenon, exemplified in the development's riverfront promenades. Comparing the promenades at the centre of the Sabarmati redevelopment with the Indian government's Swachh Bharat Mission, I showed how the presence of this spatial typology could not be dismissed as simple infrastructural fetishism or spatial mimicry. Instead, it stood as a material trace of 'rule by aesthetics' (Ghertner, 2015), the quest to appear new, while catering to the aesthetic and sensory preferences of those perceived to be driving development and modernisation. Readily apparent in these 'European-style' promenades, this logic also applies to the gated parks and gardens frequented by the city's urban middle classes, the luxury developments

appealing to foreign investors and the Gujarati diaspora, and the cultural practices and 'sentimental' performances anticipated by Subhash park's stepped auditorium. (cf. Da Costa, 2015)

The Sabarmati development has had tangible effects (cf. Namba, 2017), and helped realise many of its planners and advocates' strategic goals, by, for example, clearing the riverfront of informal settlements and housing, and attracting foreign investment to the city. Revisiting architect Bimal Patel's comments on the need for 'adjustment' (cf. Shah, 2015: 54), Mona G. Mehta describes how the experience of the development has not been one of mutual accommodation and compromise, but 'occupation, twice over'—the initial dispossession and displacement of slum-dwellers joined, latterly, by an appropriation of the space by the city's middle classes, seeking to escape the effects of congestion, air pollution, and overcrowding. (Mehta, 2018: 24) Ostensibly 'successful' on these terms, but accomplished at great cost, whether the Sabarmati redevelopment constitutes an 'appropriate' intervention (cf. Dempsey et al., 2018: 286), and the relationship between 'appropriateness' and a project's realisation, remain open to further examination—questions which anchor this study's concluding chapters.

8.4. Discussion: Worlded infrastructures?

Building on my analysis of mutability and mobility in Chapters 7 and 8, this chapter identified worlding as way of sensitising my analysis to the role and implication of infrastructure in further-reaching political projects. Chapter 6 examined mutability and material resistance, critiquing constructivist accounts of technological stabilisation and closure. Chapter 7 focused on the movement and circulation of infrastructure, showing how the contrast between a relocated technological entity and its new setting renders cultural difference visible. As with *Solar Impulse 2* and the supposed 'new roads in Varanasi', the two cases in this chapter concern ostensibly 'foreign' entities; the bicycle (cf. Arnold, 2013; Arnold and DeWald, 2011), and a 'world-class' waterfront regeneration, funded by the development of reclaimed land.

Although the green MYBYK bicycles typically formed part of a bike-sharing service mediating the performance of the city's Janmarg BRT system, the meeting at Soni's offices enabled these artifacts to be repurposed for the Women on Wheels fundraiser. Removed from their usual infrastructural context, MYBYK's green bicycles were re-worlded by their

association and co-enactments with Pedal for Fun and their trainee driver beneficiaries. Taking a similar approach to the differential enactments of the riverfront development, and using methods informed by *flânerie*, I scrutinised a series of material details tracing the planner's worlding practices and wider dynamics of urban sociotechnical change. (Pusca, 2008; 2009)

The SRFDC perceived the gap between existing, customary uses of the Sabarmati and their vision of a 'world-class' riverfront as a threat, imperilling the integrity of the vision. Responding by 'othering', denying, and relocating the difference represented by local slum-dwellers and their livelihoods, the project's re-worlding of the riverfront displaced one landscape with another. In contrast, MYBYK and Pedal for Fun's re-worldings of the bicycle turned on novel enactments of context, as each group worked to create defensive distinctions (Anantharaman, 2017) that would distance their cycling practices from those of India's low-caste urban poor. In this case, non-coherence was a desired outcome, enabling the city's recreational and commuter cyclists to separate themselves, socially, from the trappings of 'old' India and its pre-reform consensus. Both cases track dynamics of class capture (Mehta, 2018) and aesthetic governance (Ghertner, 2015), as an assertive Indian middle class has made its influence felt by laying claim to infrastructure and urban space.

Avoiding easy recourse to a totalising global-local dyad 'abstracted from place' (Stead, 2016: 34), worlding practices are better positioned to accommodate multiplicity, and the practical enactments of apparently fixed or self-evident scales. In their work on infrastructures as ontological experiments, Casper Bruun Jensen and Atsuro Morita identified an intensified scholarly interest in those 'processes of materialization through which the 'global' enters the 'local' (and vice versa).' (Jensen and Morita, 2017: 617) It is precisely these processes that I sought to highlight in this chapter, by attending the material components and practical effects of different enactments of context. (Tsing, 2010: 49) In these cases, the local and the global are 'not endpoints on any absolute scale', but constructed contexts, enacted and 'enfolded in each other' (Hastrup, 2013: 148).

In this chapter's two cases, I showed how different worldings—urban bike-sharing infrastructure, recreational cycling, International Women's Day, the young urban professional woman, the 'desired pedestrian' (Thomas, 2016), the 'Riverfront Market' (Lauer, 2016), 'European-style' promenades, the 'world-class' urban development (Ghertner, 2015), and a 'new' India (Kaur, 2012)—have been produced, enacted, and

performed. Such an approach can be applied elsewhere, equally suited to discussions of smart cities, temple projects, special economic zones, irrigation schemes, or other 'infrastructural' subjects. Although it is tempting to reduce worlding to a question of representation or discourse, practical enactments of context have tangible, material consequences (cf. Namba, 2017), and deserve greater scrutiny and analysis.

Following Annemarie Mol (2002), my key proposition is that those elements we might otherwise take to be obdurate retain a hidden or latent malleability, susceptible to 'adjustment' (Dyson, 2017), *jugaad* (Sekhsaria; 2013; Rai, 2019), or re-worlding (Tsing, 2010) by suitably positioned actors. In the concluding chapters, I examine uses of 'appropriateness' as a normative criterion, using this to further elucidate on this relationship between malleability, context, and difference. Following an interlude sharing my encounters with grassroots innovation in Ahmedabad and Delhi, I return, briefly, to questions of context and appropriateness, before extending these same questions to infrastructure and urban development. In the final chapter, I return to my original research questions, before reflecting on the study's wider contributions, and how effective my research practices and analysis has been at addressing the issues and questions identified in the introduction.

Interlude: Bungalow No. 1. to Rashtrapati Bhavan

In March 2016, I make an appointment to visit the Ahmedabad office of India's Grassroots Innovations Augmentation Network (GIAN).[206] Catching an auto-rickshaw from outside my hotel, the roads are still dark with moisture from last night's rain, which has taken the edge off the city's smog.[207] Arriving ahead of schedule, I linger in the compound's well-tended communal garden, before strolling back across to Bungalow No. 1., which GIAN shares with India's National Innovation Foundation.[208] Scrawling my name and contact details into a ruled notebook, to the satisfaction of the uniformed security guard, I take a seat in the lobby. A fingerprint scanner is mounted on a wall by the door, above an intricate tapestry depicting a landscape populated by elephants, oxen, and horseback riders, and alongside a pin board covered with English- and Hindi-language press clippings. As I wait, a couple of young women sign in using the scanner, which flashes green in approval.

Dinesh[209], my contact at GIAN, recognises my name from a grassroots innovation conference at Ahmedabad's Indian Institute Management, held the previous year. This was where I had started my field research in Ahmedabad, co-presenting a paper based on some Masters-level coursework on a US open hardware[210], to an audience of Indian academics, technicians, farmers, and engineers. Amid a jet-lagged blur of paper presentations on topics spanning low-cost, buffalo-proof toilet blocks made from quarry waste[211], the organisational innovations of rug-weaving social enterprise Jaipur Rugs[212], and Buddhist monastic organisations' lessons for management practice[213], the conference had also included a plenary address by A.P.J. Abdul Kalam, the silver-haired aerospace engineer turned 11th President of India, and, memorably, an exhibition of grassroots innovations on the university cricket pitch.

[206] Established in 1997, GIAN works to commercialise grassroots innovations; enabling participating innovators to sell their products by creating 'a joint company with an experienced entrepreneur' or facilitating the transfer of technology 'for further commercialization by a third party.' (Smith et al., 2007: 147)
[207] From field notes, 3 March 2016.
[208] An autonomous government body sitting under the Department of Science and Technology, India's National Innovation Foundation (NIF) was set up in 2000 to provide institutional support for the scouting, development, and diffusion of grassroots innovations and traditional knowledge.
[209] This is a pseudonym.
[210] Pickard and Voss (2015).
[211] Rao and Narayan (2015).
[212] Mitra et al. (2015).
[213] Goonatilake (2015).

Figure 10. Vertical windmill, IIM-Ahmedabad, 19 January 2015.

Laid out on the grass, as kites and raptors circled overhead, this diverse array of projects and technological artifacts were drawn from a database maintained by SRISTI, the Society for Research and Initiatives for Sustainable Technologies and Institutions.[214] These included bicycle- and pedal-operated pumps, devices to scale coconut trees, and a windmill from Tamil Nadu, with three v-shaped, bright green blades (Figure 10). A prototype robot, funded by the R&D wing of the University of Petroleum and Energy Studies, was designed to collect pine needles; identified as a cause of forest fires and possible feedstock for renewable energy. (Dubey, 2017) An elevated box atop six wheels, the robot nonetheless boasted a suction mechanism and obstacle detection capabilities.

[214] SRISTI ('creation' in Sanskrit) is a non-profit organisation, set up in 1993 to support and formalise the activities of the Honey Bee Network—a voluntary group working to identify and document innovation—with testing and verification. (cf. Smith et al., 2017: 146–147)

Elsewhere, I stopped to watch four men attend to an elaborate biomass gasifier. Mounted on a metal trailer frame, it made a low chugging while emitting a thick cloud of smoke. Designed to 'get clean gas and ensure smooth operation of [the] engine at low operational cost'[215], the device used an internal furnace to produce filtered gas, fed to the engine as a diesel substitute.

Back at the bungalow, one wall of Dinesh's office is filled, floor to ceiling, with shelves and cabinets, each stacked with binders of patents, regional catalogues, and field reports committing these cricket-pitch exhibits to paper. Explaining that, at any given time, most of GIAN's personnel are in the field, scoping new innovations and aiding the diffusion of grassroots solutions across Gujarat, Goa, and Maharashtra, it is clear from his manner and body language that Dinesh, too, is pressed for time. Indeed, as he explains, GIAN's entire team will be in Delhi from the following week, contributing to India's National Festival of Innovation. I am lucky to have found him. Over the next half hour, he talks me through a series of example grassroots innovations, pulling up examples on his computer.[216] With little obvious structure, hierarchy, or categorisation, the rapid succession of diverse cases is overwhelming; *here* a video of a low-cost mechanical water pump, *there* a machine for extruding logs of cow dung.[217]

After our meeting, Dinesh extends an invitation to the Delhi event over email. Seeing an opportunity to experience further examples of grassroots innovation and appropriate technology, and imagining the event as a public-facing event well-suited to my research, a week after my meeting at GIAN, I book a ticket for an Air India flight from Ahmedabad to Delhi. Coinciding with a World Culture Festival hosted by *sadhu* Sri Sri Ravi Shankar, the seats behind me on the flight are occupied by a group of young Russian musicians, their instruments stowed in the hold.[218] I take the Airport Metro Express across town from the airport, and, compared with prior experiences enduring endless queues and the scrum of other would-be passengers at the airport's police-sponsored pre-pay taxi booth, sailing

[215] Exhibit label text, from photograph, 19 January 2015.
[216] Outputs from one of the Honey Bee Network's 'impressive databases', constructed to catalogue the diverse forms of knowledge and ingenuity that pervade rural India. (Smith et al., 2017: 173) By skilfully choreographing a movement between the extensiveness of these database resources and 'inspiring individual examples', as Dinesh did here, the Honey Bee Network and SRISTI have been able to win significant institutional support, which flows, too, to the grassroots innovators. (ibid.) For more details on the origin and development of these databases, see Gupta (2006, 2012).
[217] On the work of producing and categorising data, and sustaining a database over the longer term, see Ribes and Jackson (2013), and Farquhar and Sunder Rajan (2014); I am grateful to Sandeep Mertia for making these connections.
[218] From field notes, 11 March 2016.

over congested roads feels like nothing so much as a video game cheat code. Brand new as of 2013, the carriages are clean and spacious, though the token dispensing machine at the airport station is out of action, and the digital displays are not updating.

After a night sat among a throng of local Manchester United fans in a dive bar in Delhi's Connaught Place, while exchanging WhatsApp messages with a friend on a medical placement in the South Pacific, I wake early the following morning. Uncertain as to the tone of the event, but mindful of the warm spring weather and the organisers' request to leave bags, cameras, and mobile phones at home, I don white shirt and suit trousers. Stripped of my phone's capabilities as timepiece and navigational aid, and, making the final leg of the journey by foot, I cut through the Lutyens Bungalow Zone, a couple of neighbourhoods populated by the name-plated villas and bungalows of judges, government officials, and senior military figures.[219] I make eye contact with a child leaving one of the many compounds on a tricycle, as a uniformed guard watches from behind a sandbag-protected sentry post.

With most other attendees arriving by car, the entrance to Rashtrapati Bhavan[220] sees the usual security detail bolstered by a couple of earnest young civilians in lanyards, scanning print-out bar codes.[221] After a final check where my ticket code is checked off against a list, I take a seat towards the back of several rows of chairs, facing a marquee decorated in the colours of the Indian flag. 'National Festival of Innovation' is written twice, in English and Hindi. Attendees wear turbans and kurtas and saris, smart shoes, military uniforms, awkwardly knotted neck ties. There are a couple of family groups and some British diplomats. A pair of university researchers from different parts of India make small talk, working to identify shared reference points and common ground. To the right of the audience, a small, tiered stage is occupied by cameramen and press photographers,

[219] A large, low-rise residential area, planned by English architect Edwin Lutyens to house British administrators, and occupied, post-independence, by India's politicians and senior civil servants. (Kumar, 2000: 153-156; cf. Ridley, 1998) With roughly three-quarters of properties in the Zone held by the government, its architectural design and low density has been criticised as 'reminiscent of an anachronistic, elitist, imperial past', affording 'ministers and government servants … several acres of open space around their bungalows whilst millions of people live in overcrowded slums.' (Buch, 2003: 35)

[220] Official residence of the President of India, previously 'Viceroy's House', built, again, by Edwin Lutyens, between 1912-31. A key part of New Delhi's former role and identity as an imperial city, this complex was envisaged as a material symbol of Indian 'nationalism', achieved through European ideals. Topped with a vast dome, Lutyens' design used Indian forms as punctuation marks in an otherwise classical, Greco-Roman scheme. (Inam, 2012: 126–127; Irving, 1982: 14) The building became Rashtrapati Bhavan in 1950, despite the protestations of Gandhi's followers, who had hoped it would become a hospital.

[221] From field notes, 12 March 2016.

who stand erect, brandishing shoulder-mounted camcorders and telephoto lenses. One or two swing out to get some tracking shots of the crowd, as a bird of prey wheels and banks overhead. It is hot. Regretting having skipped breakfast, I can feel a thickening dehydration in the back of my skull. Somebody's child charms a bottle of water from caterers crewing a coffee station, and I eye them with barely concealed envy.

Time passes. There is a rustle of excitement, as the president's convoy pulls through the main gates. The cameramen and photographers crowd close as the president leaves his vehicle. Climbing some steps up to the stage, he takes one of the upholstered chairs to a hesitant round of applause. After a short, inaudible address to the crowd, the president and accompanying VIPs leave the stage, and the front few rows of the audience peel away, joining this group to tour the exhibition. This takes a further half hour, after which the convoy departs, and the remaining audience floods into the marquee.

The crowd moves counterclockwise through the exhibition space. Waiting for the mass of people to thin, I linger by a modified hydroelectric turbine; a fully functional demonstration model of one of 360 such turbines installed in the inventor's home region, in Karnataka. Taking scratch notes on a couple of folded sheets of A4 I had smuggled into the event, I note some details of how this innovation has been staged, with a consistent stream of water emerging from the pipe nozzle on a mocked-up, flocked polystyrene mountainside, with painted waterfalls. Other exhibits include a Gujarati solar-powered lathe, presented as a way to support manufacturing livelihoods in areas with intermittent or unreliable electricity supply; a 'rainwater syringe' from Kochi, one example of 260 systems already in use in coastal Kerala, using pressure tanks and PVC pipes to 'inject' water underground, for subsurface storage; and, more surprisingly, a stainless steel speaker system from Tamil Nadu, piping the song of a woman vocalist into the marquee.

Attracting less attention that the more explicitly technical efforts, an assortment of novel crop varieties fill several tables. A planned emergency alert switch for public transport elides any direct mention of India's sexual assault crisis, but comes with a rudimentary three-quarter scale mock-up of auto-rickshaw, and one of the two young women crewing the demonstration ducks in, briefly, to demonstrate how it might work. From Ahmedabad, a low-cost water cooler shows the use of heat exchange to lower water temperatures by 8-10 degrees, something the innovator and supporting agencies hope to roll out as a public amenity.

Mixed in among and alongside the exhibits, posters explain the philosophy, organisational structures, and protocols of the Honey Bee Network, talking readers through the movement's philosophy, processes of scouting, documentation, and business development. One stand outlines the twice-yearly *Shodh Yatra*—a tour by foot of India's outlying villages and rural hinterland, scouting for 'oddballs', non-conformists, and the products of their ingenuity.[222] At the same time, there are many references to national policy programmes; the Make in India and *Swacch Bharat* missions are particularly prominent, with significant buy-in from the organisations and agencies present.

Beneath a row of spinning ceiling fans, sofas and pot plants fringe a large, 3-dimensional sign, its letters spelling 'FESTIVAL OF INNOVATION' in the orange and white of the Indian flag. As the afternoon draws on, small groups of attendees stop to have their photo taken with the sign. I take a seat on one of the sofas, scribbling some more notes, as a woman with a microphone and a brightly patterned silk shawl stalks the hall, ambushing innovators, and talking excitedly to an accompanying camera. A couple of middle-aged Bhutanese men in national costume, polished black shoes, and sheer socks, talk to the teenage inventor of a counter-weighted self-flushing urinal, and his adult chaperone. Making to leave the marquee, I am stopped in my tracks by a square display, roughly as tall as I am, alternating between 'onion-transplanter.mp4' and 'seeddrill.avi'—short video clips from the SRISTI database, shot at a resolution far below the enormous size to which they have been scaled.

[222] For more detailed accounts of the origins and development of the Honey Bee Network's *Shodh Yatras*, and how they provide material for the group's innovation databases, see Gupta (2006: 53–55), Smith et al. (2017: 146–149), and Daimary (2019).

Chapter 9: Appropriate infrastructures

9.1. Introduction

In this chapter, I shift from description and analysis to address some questions of normativity. I assess the utility of 'appropriateness' as a norm or criterion for evaluating urban infrastructure and development projects, while situating and historicising the concept. Reading across economist E.F. Schumacher's work on intermediate technology, the anti-colonial *swadeshi* movement, and my encounters with grassroots innovation institutions in Ahmedabad and elsewhere, comparing these different bodies of practical knowledge offers a way to move beyond dominant theories of infrastructure.

Revisiting cases from the preceding chapters, I show how mutability, mobility, and worlding lend themselves to different interpretations of context—with implications for practices of appraisal and evaluation. Linking chapter eight's discussion of worlding with normativity and appraisal, I examine how different actors' invocations of appropriateness diverge from other, more commonly cited norms. Addressing relational approaches to proximity, structural constraints, and trade-offs between different norms and values, I consider what it would take to operationalise appropriateness in a postcolonial urban setting. In the final section, I provide a provisional outline of appropriate infrastructure, as a concept centring users' needs and relevant contexts, and widening the field of potential applications beyond cases shaped by and indexed against a modern infrastructure ideal.

9.2. Normativity

In their paradigmatic account of the Zimbabwe Bush Pump, Marianne de Laet and Annemarie Mol position fluidity as a possible normative good, characterised by flexibility, resilience, and graceful failure:

> Good technologies … may well be those which incorporate the possibility of their own break-down, which have the flexibility to deploy alternative components, and which to continue to work to some extent even if some bolt falls out or the user community changes. (de Laet and Mol, 2000: 252)

This comment concedes the possibility of multiple different 'goods', deriving from different politics (e.g. distributive justice), ethics (sensitivity to users' needs), or aesthetics (ingenuity, parsimony). (de Laet and Mol, 2000: 253) Crucially, none of these goods are

universally valid. Fluidity might be valuable in situations where technologies are relocated to 'so-called intractable places'—but then again, it might not. (de Laet and Mol, 2000: 253) As John Law and his colleagues note, there are no stable or self-evident answers for how to balance these different conceptions of the good, which are often in tension, jostling and 'cut[ting] across one another' (Law et al., 2013: 191).

Although concrete examples and case studies provide a 'rich resource of goods (and bads) and *styles* of goods and bads' available for analysis (Law et al., 2013: 189), thick description is an inadequate guide for action, typically requiring a '*neutralizing* distance' that yields little additional insight about what, exactly, should be done. (de Laet and Mol, 2000: 253) The *critical* tradition, by contrast, engages directly with questions of normativity and appraisal, with would-be critics expressing their approval or disapproval of given technologies, situations, or arguments (de Laet and Mol, 2000: 253). Such moves, however, often end up enacting an imperium of ontonorms, imposing a 'single set of rules, a single version of the good' capable of encompassing all conceivable contexts. (Law et al., 2013: 190-191) Were such an approach even desirable, it is hard to see how the would-be critic can identify, much less occupy, stable positions or standpoints from which to cast judgement. Seeking a way of relating beyond description and criticism, de Laet and Mol mobilise a rhetoric of 'love' to acknowledge how they were interpellated by the Bush Pump, permitting themselves 'to be *moved by* it.' (de Laet and Mol, 2000: 253) Rather than a prescribed or stipulative standpoint, they recommend a 'travel-bag normativity' that can move between locations, while remaining open to adjustment and adaptation. (ibid: 262)

Introduced by Annemarie Mol, the idea of the 'ontonorm' couples ontology and normativity, *what is* and *what should be,* sensitising analyses to 'materialities and issues of good and bad' (Mol, 2012: 381). Different ontonorms contain and convey 'different versions of what it might be to improve' (ibid: 390); a consideration with clear relevance for infrastructure development and urban sociotechnical change. So the question of what might constitute or qualify 'appropriate infrastructure' is not necessarily something with a clear or concrete answer. At the same time, those asking the question need not simply reproduce actors' own valuations. Instead, 'appropriateness' stands as a sensitising device, surfacing tacit or latent normativities, and questioning received definitions of context. In my own response, I first look at three enactments of appropriateness, in the situated, practical knowledges of intermediate technology (Schumacher, 1973), the anti-colonial *swadeshi* movement, and the Honey Bee Network's support for grassroots innovation in India.

9.3. Appropriate technology

With rare exceptions (e.g. Smith et al., 2017), most research on appropriate technology has taken a retrospective view, focusing on developments in late twentieth-century Europe and the United States, settings where complex, capital-intensive technologies were already well established. (Pursell, 1993; Nieusma, 2004; Elliot, 2016) Advocating for 'simpler, human scale options' as 'socially and environmentally preferable alternatives' to existing technologies (Elliott, 2016: 386-387), discourses and practices of alternative technology appeared first in intentional and alternative communities focused on self-sufficiency, only later shifting to a more expansionist, outward-looking approach.[223] (ibid: 389)

In the United Kingdom, alternative technology developed in opposition to a high-centralised, large-scale, state-run energy system, challenging technocrats' assessment criteria by pluralising understandings of who qualified as relevant actors, and stressing ontonorms of decentralisation, participation, and social and environmental appropriateness. (cf. Smith, 2005: 107-108, 111) This post-war, Euro-American iteration of appropriate technology is often presented as a generalisable concept, combining a critique of hegemonic technology with a 'material and economic challenge to existing social interests' (Pursell, 1993: 630). Characterised by its elevation of 'context-suitability' as a normative good, and identifying design as a crucial point of intervention (cf. Nieusma, 2004: 13), its supporters valued technologies 'tailored to fit the [prevailing] psychosocial and biophysical context' (Willoughby, 1990: 15).

Innovation studies scholar Kelvin Willoughby distinguishes between general-principles and specific-characteristics versions of appropriate technology. The specific-characteristics approach is prescriptive, codifying 'specific and tangible operational criteria' as 'signposts' for decision-making.[224] (Willoughby, 1990: 20) A general-principles approach, by contrast, stresses the need to consider appropriateness anew in each new setting or circumstance (ibid: 19-20):

[223] For many activists, this was a movement operating at the lifestyle level; a prefigurative politics enacting a world where 'technology would be developed and used within small communities.' (Smith, 2005: 115)

[224] Darrow and Pam (1978) list, among others: low capital costs; use of local materials, skills, and labour; affordability; support for group-level rather than individual decision-making; sufficient flexible to accommodate or adapt to changing circumstances; legibility to users; and freedom from rents, requiring no further payments after installation, beyond upkeep.

> Just as a computer-based irrigation system might be rather inappropriate for a poor Malaysian rice-farmer, a book-retrieval system based on card catalogs might no longer be appropriate at the Library of Congress. (Jamison and Hård, 2003: 87)

In the general-principles approach, 'appropriate' is a qualifier, emphasising technology's role in realising certain, identified outcomes, and the importance of articulating these outcomes in each new case. (Willoughby, 1990: 19) If such considerations are neglected, the inappropriateness of a given technology might have tangible effects, manifesting 'in the severity of unforeseen side effects', its negative shaping of the dynamics and structures of its users' society, or uneven impacts on different classes of relevant actors. (Willoughby, 1990: 5) An inappropriate technology might still operate, 'but only up to a point.' (ibid: 271)

In this chapter, I use this general-principles approach to move beyond a narrow conflation of alternative and appropriate technology, as a phenomenon restricted to post-war Europe and North America. Instead, I use appropriate technology to denote a set of practical knowledges with diverse genealogies and enactments. Addressing infrastructure development in the cities and urban spaces of India's 'postreform consensus' (Kaur, 2015), my primary reference points are not in Western environmentalism and counterculture. Instead, I turn to heterodox economist E.F. Schumacher's work developing 'intermediate technology' for the developing world (Schumacher, 1990 [1973]), India's anti-colonial *swadeshi* movement, and the Honey Bee Network's efforts to foster and support grassroots innovation.[225] Taking these three cases of 'artisanal knowledge' (Santos, 2018), I explore how their enactments of 'appropriateness' and context have been embedded in collective social practices.

9.3.a. Intermediate technology

E.F. Schumacher's formulation of intermediate technology (Schumacher, 1990 [1973]) took a specific-characteristics approach to appropriateness, stressing the role of small, simple, capital-cheap technologies in addressing the underdevelopment of the global south. (Willoughby, 1990: 115) Criticising the 'global experiment' in technology transfer that followed the Second World War (Philip, in Greenspan et al., 2016: 253; Nieusma, 2004: 13), Schumacher and his followers positioned intermediate technologies as a response to largely failed attempts to accelerate industrial development in former colonies by importing capital-intensive technology from the developed world. (Arnold,

[225] See previous interlude; pp. 231–236.

2005: 94; Willoughby, 1990: 60) Critiquing capital-led development, centralisation, and resource-intensiveness, intermediate technology sought to realise a 'globally sustainable technics', rooted in tools that could be used and maintained without expert knowledge. (Jamison and Hård, 2003: 87)

For Schumacher, the best interventions were those that freed poor communities from their dependency on foreign aid, supporting economic self-reliance by providing knowledge, rather than linear transfers of turnkey technology. (Willoughby, 1990: 134-135) Positioned between inexpensive indigenous solutions and the complex, capital-intensive technologies of the West, intermediate technologies were labour-intensive, relatively simple, legible to their users, and designed for use in small-scale settings, and on-the-spot maintenance and repair. (Schumacher, 1990 [1973]: 148-149; Leonard, 2018: 25) Supporting a regional approach to development (Schumacher, 1990 [1973]: 145), these intermediate technologies would reduce the need for Western experts with specialised maintenance and management skills. (Willoughby, 1990: 116) This relative simplicity, Schumacher claimed, would stop the benefits of new technology being captured by a 'fortunate minority' in urban centres and the formal economy (Schumacher, 1990 [1973]: 145-146), contributing to 'isolated islands of technology' that increased inequality and destroyed local production. (Leonard, 2018: 256) Intermediate technology, in short, was *accessible*, standing in 'some definable relationship to the level of resources and wealth in the society in which they are to be used.' (Schumacher, 1990 [1973]: 109)

Seen by many as a 'misguided heretic' and 'romantic conservative … prone to idealizing peasant life', Schumacher was one of few notable Western critics of post-war development—extending and applying non-Western analytical resources, including Buddhist and Gandhian critiques of technological civilisation. (Leonard, 2019: 24; 2018: 258, 262-263) Drawing on his experiences as a UN consultant in Burma in 1955, evaluating the newly-independent state's plans for social and economic development, Schumacher's writings stressed the need for limitation, restraint, and non-violence[226]—and, where possible, freedom from foreign influences. (Leonard, 2019: 2) Sketching the outlines of a non-materialist, or 'Buddhist', economics, he drew extensively on Gandhi's writings, in which:

[226] Understood here as a question of ecological sensitivity, but also the exclusive use of local resources, and minimisation of unintended negative externalities. (Willoughby, 1990: 117)

> Material things were only important up to a point. If economic conditions could be broadly classified as corresponding to misery, sufficiency, or surfeit, then only the second of these was good. (Leonard, 2019: 21)

Making repeat visits to India in the 1960s, Schumacher's developed his knowledge of Gandhi's economic theories, and those of his interlocutors. (Weber, 1999: 357-358) More pronounced in his earlier writings, the Gandhians' influence on Schumacher's critique of economic development later took a back seat to his experiences in Burma, subsumed in his wider argument and theoretical formulations. (Weber, 1999: 350; Leonard, 2019: 23)

In the 1960s, Schumacher's ideas found an expression in the work of the Intermediate Technology Development Group (ITDG), a development organisation he co-founded, which aimed to present an alternative to the massive infrastructure and industrial projects favoured by international organisations such as the World Bank. (Leonard, 2019: 24) From its founding, the ITDG enjoyed an 'unusually active' engagement with the world of philosophy and ideas. (Milner, 2017: 112) In 1967, the organisation launched a catalogue of intermediate technologies, *Tools for Progress*.[227] This catalogue enabled the group to build a network of sympathetic specialists, hire permanent staff members, and incorporate intermediate technologies into development programmes funded by the British Ministry of Overseas Development, and other European countries. (Milner, 2017: 113; Leonard, 2018: 260-261) ITDG subsidiaries focusing on energy, transport, consultancy, and books were established through the 1970s. (Milner, 2017: 113) The group began publishing the quarterly journal *Appropriate Technology* in 1973. In 2005, it became Practical Action, which is still active as one of the UK's leading development charities, producing and disseminating knowledge. (ibid: 115-117)

9.3.b. Swadeshi technopolitics

Tracking the genealogy of Schumacher's formulation of intermediate technology back to the Gandhians, it is possible to see the influence of an anti-colonial Indian technopolitics that long preceded his visits to independent India. With colonial India being drained of its wealth and resources by British rule, this technopolitics built on the principles of *swadeshi* ('our own country') and *swaraj* ('self-rule'), which together formed a cohesive 'meta-cultural' development paradigm. (Bakker, 1990: 52; Arnold, 2013: 96)

[227] 'For every tool, machine and other item of equipment illustrated, the [catalogue] provided an illustrated description and the name of the British company from which it could be ordered.' (Leonard, 2018: 259)

Seeking to strengthen indigenous institutions weakened by colonialism, such as the *panchayat* village assembly, *swaraj* approached self-rule as a goal requiring economic, cultural, and social development, alongside independence. (Bakker, 1990: 52, 59) Supporters believed an emphasis on 'local self-reliance and indigenous technologies' could mitigate the turbulence of transition, helping shift independent India towards a future of self-supporting, self-contained villages. (ibid: 60) A corollary of *swaraj*, *swadeshi* steered supporters to the 'use and service of [their] immediate surroundings to the exclusion of the more remote.' (Gandhi, 1919: 273) Scaled to the level of the imagined nation, *swadeshi* practices and technologies sought to secure India's long-term autonomy as self-governing, economically self-reliant, and free from colonial control. (Goswami, 2004: 251, 274)

With its origins in Indian nationalists' boycott of British goods after the 1905 partition of Bengal (Chandra et al., 1989: 132-143), the *swadeshi* movement preceded Gandhi, but was emblematised by his promotion and use of the portable spinning wheel, or *charka*, as a practical tool and symbol of non-violence (Figure 11). (Bakker, 1990: 61; Menon, 2020: 643-644, 653) Valued for its capacity to fulfil the basic need of human clothing, the *charka* provided a way to circumvent industrial Britain's textile mills, a chokepoint for Indians' self-provisioning under colonial rule. (Arnold, 2013: 18-19) Gandhians promotion of *khadi* (homespun cloth) reflected their support for a decentralisation of production and consumption, as a means to provide income without forcing people to relocate from their villages, and alleviate the failings of an inappropriate economic system. (Weber, 1999: 357) At the same time, this was more than just a political or economic move:

> The spinning wheel also promised to end many other forms of impoverishment. It fulfilled a moral requirement, regenerated atrophied physical capacities, created social solidarities across impersonal communities, and through its therapeutic qualities was the means to spiritual development, paving the path to true swaraj. (Menon, 2020: 646)

Incorporated into the experimental practices of Gandhi's urban laboratory at the Sabarmati Ashram, spinning became a 'reviving draught', capable of sharpening participants' skills and slowing physical decline. (ibid: 654-655) Although Gandhi's aim of revitalising rural India through the *charka* struck many as anachronistic (Weber, 1999: 356), from the 1920s, the widespread use of *khadi* imbued Indian nationalist politics with 'ceremony, drama and participation' (Ninan, 2009: 194). Enabling wearers to enact a narrative of 'national identity and self-reliance', the homespun textile and its means of production prefigured a 'cultural and economic alternative' to colonial rule. (ibid.)

Figure 11. Portrait of Gandhi using a *charka*, Sabarmati Ashram, 19 January 2014.

A second, striking example of *swadeshi* technology can be found in the history of independence leader V.O. Chidambaram Pillai's Swadeshi Steam Navigation Company (SSNCo), an 'almost unbelievably optimistic' indigenous shipping business established in Tuticorin in 1906, to compete with the monopolistic British India Steam Navigation Company (BISNCo).[228] (Davies, 2020: 77) Pillai hoped to mobilise indigenous Indian capital to establish a cheap, reliable steamship service between India and Ceylon[229], develop local expertise in navigation and shipbuilding, and support local industrial development—with the long-term aim of displacing British and foreign enterprises.[230] (Davies, 2020: 75-77; Flora, 2014: 196-197) Running two reconditioned French mail steamers from 1907, SSNCo offered passage to passengers and cargo. (Khilnani, 2016:

[228] I was first introduced to this case by an episode of Sunil Khilnani's BBC 4 Radio series *Incarnations: India in 50 Lives* (2016); see also Khilnani (2016).
[229] At the time, one of the largest shipping lines in the world. (cf. Davies, 2020: 69)
[230] Founded as a joint stock company, shares in SSNCo were issued exclusively to Indians, Ceylonese, and citizens of other 'Eastern' nations. (Flora, 2014: 198)

390) The British responded by dropping BISNCo's rates, sparking a price war between the two operators. (Flora, 2014: 208) In addition, geographer Andrew Davies cites evidence of a 'secret convention' between BISNCo and railway companies, who agreed to offer discounted train travel for BISNCo passengers. (Davies, 2020: 79) Initially putting up a brave fight, Pillai's involvement in labour agitation at British-owned mills saw him charged with sedition; a terminal encounter with the colonial state that doomed SSNCo to collapse, while he served a four-year jail sentence. (Khilnani, 2016: 393, 395)

Writing in *Hind Swaraj*, Gandhi claimed 'railroads, trams, automobiles, and flying machines' epitomised a 'soulless, avaricious modernity' that had drained India of its wealth. (Arnold, 2013: 18) However, the contrasting cases of the *charka* and Pillai's steamships show the pragmatism of *swadeshi*, as something hewing closer to the general-principles version of appropriate technology, rather than a stipulative list of desired characteristics. Although Gandhians pursued technological choices that supported decentralised autonomy, equity, labour-intensiveness, environmental sensitivity, and local production (Ninan, 2009: 186), these principles found different expressions in different contexts, with a diverse range of machines and devices claiming 'swadeshi credentials' (Arnold, 2013: 99). Though a given artefact, such as a *charka* or bicycle, might prove more suited or easily adapted to 'certain forms of social and political organization' (ibid: 190), appeals to *swadeshi* and *swaraj* values rebuffed technological determinism, asserting the primacy of producers and users. (ibid: 186)

The fact that a *swadeshi* steamship was imaginable, let alone capable of operating successfully for two years, shows how *swadeshi* also operated symbolically, highlighting the central role of artefacts as expressions of values. (ibid: 186) With *swadeshi* also encompassing practices of appropriation by which foreign objects were 'rendered indigenous' (Arnold, 2013: 119), SSNCo's ships were effective vehicles for the *swadeshi* cause, reworking established technological artifacts to propagate nationalist sentiments and an anti-colonial message. (Davies, 2020: 85)

9.3.c. Grassroots innovation

As described in the interlude preceding this chapter, my encounters with Indian grassroots innovation institutions unsettled the distinction between researcher and subject. At Bungalow No. 1, IIM-Ahmedabad, and Rashaptri Bhavan, I found myself 'cheek

by jowl' with other experts and practitioners, who were, like me, 'tracing and manipulating concepts' as they moved from place to place. (Candea, 2019: 141) Comprising a shared database, and a network of members who 'scout out, develop, sustain, and reward' grassroots innovations of various kinds (Gupta, 2006: 50), the Honey Bee Network (HBN) was founded in the late 1980s by Anil Gupta, a management professor with a background in agronomy.[231] Motivated by a concern that foreign consultants and academics were exploiting Indian knowledge without sharing their gains, Gupta aligned his volunteer network with policymakers supporting the liberalisation of India's economy, seeing a way to secure property rights and legal protection for indigenous forms of knowledge. (Smith et al., 2017: 156, 150-151) Blending post-reform free-market economics, Gandhian politics, and appeals to cognitive justice (Visvanathan, 2006), the Honey Bee Network is one example of how traditional, practical knowledges can be documented and recognised in postreform India. (Gupta, 2006: 49)

Rather than resisting modernisation and market liberalisation, the Honey Bee Network and its various offshoots[232] have aligned grassroots ingenuity and technological *jugaad* with capitalist enterprise, helping rural inventors secure IP rights, and access investment finance and product marketing. (Kaur, 2016: 324) In their own terms, much as a honey bee 'connects one flower to another through pollination, removing the nectar without harming the flowers', the HBN's activities re-world India's poorer regions from a 'sink for aid and advice' to a 'source of inventions and innovations.' (Gupta, 2006: 50) This re-worlding has been shaped by ideas of cognitive justice and critiques of the geographies of technology transfer, in which 'science originates at the centre and development occurs at the periphery.' (Visvanathan, 2005: 86) For advocates of cognitive justice, technology transfer enacts a linear singularity of 'pre-empted futures', where the only alternative to development is 'museumization' and marginalisation.[233] (ibid.) Seeking to avoid this fate, cognitive justice demands the presence of all relevant actors in processes of development and technology transfer, through active participation, but also *cognitive representation*—

[231] Informed by his experiences of 'extractive' research into agricultural practices, as part of a project funded by the Bangladeshi government. (cf. Gupta, 2016)
[232] A complex system of overlapping institutions, creating a pipeline where grassroots innovations are first identified by Honey Bee Network volunteers, tested and appraised by SRISTI, then promoted and commercialised by GIAN and the NIF. As of 2017, more than 60 technological licenses had been granted to small companies and entrepreneurs, with benefits flowing back to the original inventors. (Smith et al., 2017: 156)
[233] As one example, consider the rainwater-fed *tanki* systems described in Chapter 6, and the challenges in 'reactivating' these dormant, fossilised artifacts and their attendant knowledges.

seeking open, flexible approaches that can reflect the plurality of knowledges, and the mesh of relations 'between knowledge and livelihood and lifestyle.' (ibid: 92)

In the case of SRISTI and the Honey Bee Network, demands for cognitive justice and representation have been met, to some extent, through regular *shodh yatras*, or expeditions for knowledge. Where modernity produced a 'monoculture of the mind', cognitive justice approaches such as the *shodh yatra* recognise diverse ways of knowing and being. (Visvanathan, 2006: 164) Organised twice yearly, and covering some of India's more remote, *mofussil*[234] regions, participants hike roughly 150 miles over a week, following a route with few, if any, formal road connections. Participating researchers meet with local villagers, farmers, and artisans, producing a collective report[235] based on general meetings and members' individual experiences. Running alongside the search for new innovations, researchers share their database and discoveries from previous expeditions as prompts for discussion and feedback. (Utsyuzhantseva, 2021: 60)

Visiting the Honey Bee Network's offices in the early 2000s, Harald Bekkers describes a 'few rooms in the IIM-A', staffed mainly by student volunteers, inspired by their professor. (Bekkers, 2005: 65) GIAN, then 'operating from a modest apartment' and with Gupta as a young CEO, presented itself as a 'clearing house for innovations' (ibid.). A charismatic leader and powerful advocate for grassroots innovation, aligned with a Gandhian faith in the potential of ordinary people, Anil Gupta was able to project the image of someone successfully mediating between global and local worlds. (Kaur, 2016: 324; Smith et al., 2017: 150) Sourcing 'affordable, repairable, and clever technologies' from rural India to the benefit of the country's emerging market economy, he showed how even remote regions and villages had technologies and forms of knowledge that were 'ripe for capitalization.' (Irani, 2019: 6) This required disembedding intensely situated technologies and knowledges from their local settings and rendering them mobile; whether as stable artifacts or blueprints for further development.

The shift from the small-scale, para-academic contexts described by Bekkers to the arrangement I encountered at Bungalow No. 1. tracks the institutionalisation and improved status of innovation as an Indian state project. (Irani, 2019: 90; Kaur, 2016: 317-318) As part of this transition, the Honey Bee Network's legitimation and support for grassroots innovation reconfigured a pre-existing *swadeshi* technopolitics. Adapting the

[234] A term denoting rural and provincial areas, an 'uncivil outside to urban sophistication' structured by 'relations between headquarters and hinterland' (Hoek, 2012: 40, 29).
[235] Published in English and relevant local languages.

swadeshi movement's Gandhian precepts to meet the challenges of a globalising, postreform market, Gupta and his colleagues succeeded in transcending Gandhi's fears of mechanisation without sacrificing earlier commitments to context-sensitivity and cognitive justice.

9.3.d. Discussion: Appropriate technology as practical knowledge

These three appropriate technology practices—intermediate technology, *swadeshi*, grassroots innovation—illustrate the diversity of practical knowledges. (Santos, 2018: 3) These currents of practice are relational, struggling against hegemonic, monocultural 'temptations' from within and without (Santos, 2014: 175), while troubling any clear-cut dichotomy between modernity and tradition. Where tradition is often treated as uniquely partial, collective, and situated, 'strongly embedded in the local' (Santos, 2014: 200), a sensitivity to different actors' appeals to context highlights how modern technological and infrastructural knowledge is *also* partial and situated, emerging from and shaped by a particular territory—despite its totalising claims.

Reading across these example knowledges reveals the extent to which E.F. Schumacher and Anil Gupta both draw on Gandhian and *swadeshi* technopolitics. Although enactments of intermediate technology and grassroots innovation differ, they share a common preoccupation with the relations between a given technology and its contexts of design and use. For Schumacher, the most important context was the small-scale, often informal settings of regional India, untouched by the few 'isolated islands' of ostensibly successful technology transfer. (Leonard, 2018: 256) The *swadeshi* movement sought to replace colonial technology with machines that could serve both the Indian nation and its supporters' 'immediate surroundings' (Gandhi, 1919: 273). For the Honey Bee Network, the context was *mofussil* India, re-worlded as a wellspring of innovations and grassroots ingenuity. (Gupta, 2006: 50) In the following sections, I build on these examples, explore different understandings of context with reference to relevant cases from my own research.

9.4. Making contexts

Different versions of appropriate technology have, in different ways, favoured interventions adjusted to suit prevailing psychosocial and biophysical contexts. (Willoughby, 1990: 15) Context often appears as an explanatory staple and normative imperative; a self-evident, black-boxed set of 'external circumstances' to which objects must yield. (Woolgar and Lezaun, 2013) In his writings on context-aware computing, Paul Dourish takes a different approach, differentiating between *representational* and *interactional* interpretations of context. (Dourish, 2004) In representational accounts, context denotes the features of a given setting. For interactionalists, however, context is something people *do*; a localised achievement, with tangible material effects, actively produced through social practice. (Seaver, 2015: 1105; Asdal and Moser, 2012: 294; Dourish, 2004: 22) Where calls to contextualise typically assume issues and objects are separate from their surroundings, 'establishing context' is a *political* project, bound up with questions of method and practice. (Seaver, 2015: 1106) Since, for interactionalists, context is not self-evident, any analysis of the boundaries between context and content entails choices about what is salient, and 'where the work of contextualization should cease.' (ibid.)

For anthropologists, an early emphasis on holism and local field sites has, in recent decades, yielded to a relational understanding of context as comprising a 'set of *connections* between the object of inquiry and its surroundings.' (Morita, 2014: 215) As anthropologist Nick Seaver observes, while 'it is common sense that to put things *in context* is good and to take them *out of context* is bad', this has often overshadowed disagreements over what, exactly, context is. (Seaver, 2015: 1105) At the same time, much work in STS has been shaped by an imperative to avoid either explaining science by its own internal logic or reducing it to a function of its social environments. (cf. Asdal and Moser, 2012) In both fields, a once common explanatory recourse to context has faltered, finding 'nothing "beyond" [or outside] with which to explain something else.' (ibid: 295)

In Chapter 8, I used a register of worlding to discuss how actors 'locate the contours and parameters' of their operational contexts. (Stead, 2016: 33) This includes the actions of researchers and appropriate technologists, whose 'propositions about context' stand alongside those of planners, politicians, cyclists, and engineers. (Tsing, 2010: 49) Adopting an interactionalist approach, I follow Seaver, who urges us to attend to different 'context cultures', and their tensions and non-coherences. (Seaver, 2015: 1106) In this reading,

context is specific, local, and multiple, with diverse possible 'contexts … jostling against, and interfering with, one another.' (Asdal and Moser, 2012: 301) To understand how these plural possible contexts inform different understandings of appropriateness, I return to my observations in Ahmedabad, which illustrate how different versions of context are produced through relations of mutability, mobility, and worlding.

9.4.a. Mutability and context

In writings on infrastructure and sociotechnical change, context typically appears as the relatively stable, naturalised backdrop for a given project or intervention. To take one example, the multi-level perspective on transitions to sustainability identifies context with the *landscape*, a 'macro-level structuring context' encompassing slow-moving developments and unforeseen or exogenous shocks. (Geels, 2005: 451; Sovacool and Hess, 2017: 709) Indicative landscape-scale factors might include environmental or demographic change, social movements, new scientific paradigms, and cultural or ideological shifts. (Smith et al., 2010: 440-441) A shaping force, these contextual factors form 'gradients' for action, and can reinforce the dominant trajectories of existing sociotechnical pathways, or else drive support for alternatives. (Geels, 2005: 451; Sovacool and Hess, 2017: 709) In work on the histories of large technical systems, a given system's context is coextensive with its operating environment, encompassing the sum of local, nontechnological conditions shaping a mature system's design and configuration. These include factors of geography, resources, politics, and social, legal, cultural, and historical conditions. (Ewertsson and Ingelstam, 2005: 297) Over time, as a given technical system develops and matures, the pressures of this operating environment contribute to a distinct technological style. Differences between contexts, rendered durable in these styles, can present obstacles to those seeking to transfer designs between settings.

Emphasising mutability over dynamics of closure, the cases in Chapter 6 support an interactionalist conception of context, as something emerging from the relations between more-or-less novel and obdurate entities. (cf. Maassen, 2012) In my encounter with new street lighting in the *pols*, difficulties delineating content and context saw me mistake newly installed municipal streetlights for an intervention supporting residents' appropriation of urban space. Their sudden appearance obscured the lights' obduracy and infrastructural properties, showing the challenges in separating infrastructural systems from their wider environment. As Atsuro Morita notes, such delineations can prove more

challenging for scholars of non-Western technoscience, for whom 'conventional' local contexts do not always provide a useful unit of comparison. (Morita, 2014: 219)

A situated response to seasonal water scarcity, Rudabai's stepwell in Adalaj supports an unusually tight coupling of a technological system and its local environment, relying on the presence of a subsurface aquifer to function. Although most stepwells were shuttered under colonial rule, this structure has survived as a popular tourist site and locus for religious practice, its classification as a recognised archaeological monument fixing the stepwell's form. The *tanki*, or mass-produced plastic storage tanks, that Ahmedabad's residents use to manage an intermittent piped water supply reveal a different understanding of context. In this case, households approached municipal infrastructure as a static context for their own improvisational practices, blending user innovation and technological *jugaad*. Unable to pressure the AMC into extending the hours of supply, residents have extended the outermost capillaries of the city's sclerotic water network by fitting storage tanks on their rooftops. Filling these tanks when water is available, they create a local resource that can be accessed as needed, modifying the performance of an incomplete infrastructure otherwise beyond their control.

Tankas are limestone-blocked underground cisterns once used as a water source, that have since been bricked up or otherwise fallen into disuse. The material remnants of an earlier sociotechnical regime pre-dating Ahmedabad's piped water supply, *tankas* were designed to be filled by rainwater harvesting systems activated during the monsoon season, and operating at the household-scale. Bought to Western India by the Parsi Zoroastrian community, and mostly limited to Ahmedabad's historic walled city, the *tanka* was a situated response to water scarcity, much like the stepwell. Despite the recognised potential of the *tanka* as a water source, recent attempts to return them to use have proven unsuccessful, blocked by the separation of cisterns from their supporting rainwater harvesting systems, and a loss of the culturally embedded practical knowledge required for operation and upkeep. In this case, the salient context comprises a mix of religious beliefs, situated knowledge marginalised in the shift to piped water, and forms of social and architectural organisation associated with the city's *pol* morphology, which no longer command the same convening power.

Examining the relationship between Ahmedabad's MYBYK cycle-hire service and the Janmarg Bus Rapid Transit system prompts further questions about attributions of context. In the new BRT's reconfiguration of the streetscape to accommodate dedicated

busways and terminals, context appeared as a residual obstacle and source of material resistance. Although many religious structures were relocated, a couple of temples, memorials, a nationalist landmark, and electricity pylons proved immovable, requiring alterations to the planned design. (cf. Gautam et al., 2014) Later, the co-location of MYBYK stations and Janmarg terminals enacted the BRTS network and its built infrastructure as a context for the bike-sharing service. Access to these prime locations guaranteed exposure to a captive potential user base, with an intervention by then Chief Minister Narendra Modi enabling MYBYK to overcome material and institutional barriers to entry. The action of a local political regime valuing entrepreneurship, innovation, and infrastructure, support for MYBYK was contingent on its ability to extend and improve the Janmarg BRTS's service, while boosting the city's environmental and developmental credentials. Once Modi became Prime Minister, however, MYBYK struggled. The political context had changed. Ignored by the Municipal Corporation, and with space for new facilities constrained by Ahmedabad's existing built environment, the service faced obstacles unforeseen by its founders, and beyond their control.

In these cases, delineations of context are an outcome of the interactions through which different configurations of stability, novelty, mutability, and obduracy become meaningful. (Maassen, 2012: 456) Considering appropriateness as a normative good or criterion for appraisal, these examples show how a particular infrastructural configuration can simultaneously be one actor's system and another's operating context. Contextualising often rests on actors' identification of relations of mutability and obduracy, which are often more visible in infrastructure and the urban built environment. In such situations, 'harder', slower, and more systemic entities are typically identified as contexts, particularly where they pre-date newer and less durable interventions, or those more easily attributed to a designer or creator.

9.4.b. Mobility and context

A focus on infrastructural and technological mobilities suggests an understanding of context as something locally rooted, preceding the arrival of a technology designed or developed elsewhere. In Chapter 7, I used a mobilities-based approach as an alternative both to linear, point-to-point technology transfer, and diffusionist theories of innovation common in management and economics. In both cases in that chapter, lateral movements envisaged as smooth and straightforward instead revealed the disconcerting misfits

between a given artifact and a new environment, which were often unanticipated by its original designers and engineers.

Posted and framed as satire, the 'New Roads in Varanasi' Facebook post claimed to depict a new road, built by Japanese engineers in the city of Varanasi. In this post, the mismatch of a new infrastructure and its existing context is collapsed to a question of language, with the presence of painted kanji spotlighting a gap between the new road's Japanese engineers and its Hindi-speaking users. Literalising the need for cross-cultural translation, the depicted scenario showed the weaknesses of one-size-fits-all approaches to transferring technology from an 'advanced' core to a grateful periphery. (cf. Garb and Friedlander, 2014) Alongside the social and cultural contexts represented by linguistic difference, the framing of the 'New Roads in Varanasi post' also flagged the importance of political context for infrastructure and urban development projects. Satirising the internal contradictions and material failings of top-down, centralised, capital-led infrastructure development, the post's framing and caption showed how even a failed project can be hailed as a success, if it serves a prevailing political context. Though the new road failed to yield to the needs of local users, the project's status as a valuable symbol of modernity and development is depicted as sufficient to overcome any obstacles to construction.

Where the 'New Roads' post used linguistic difference as a proxy for sociocultural context, my encounter with experimental solar-powered aircraft *Solar Impulse 2* showed the role of racial difference in mediating the relations between a foreign technology and its Gujarati audience. A prototype vehicle and demonstration of 'clean' mobility, the aircraft was an immutable mobile, circumnavigating the globe to spread a message of business-led sustainability and technological innovation. In this, the aircraft contained several new technologies and renewable energy innovations, which the Solar Impulse team portrayed as market-ready, with public relations the only obstacle to their rapid scaling and wider diffusion. Convinced of the universal applicability of their pro-business message, deemed equally relevant for audiences in Ahmedabad as those at the COP21 UN conference in Paris, the Solar Impulse team elided the role of local context in the development and application of renewable technologies.

Freighted with the promise of innovation and clean energy, *Solar Impulse 2* drew an enthusiastic Gujarati public, keen to experience the prototype aircraft first-hand. Queuing at the airport, glimpses of the mission's majority-Swiss ground crew sensitised me to the whiteness of Solar Impulse's mobilities and neglect of context. Finding myself on the

wrong side of a colour-line marked by bamboo and policed by local private security (cf. Du Bois, 1903; Elias, 2015), this boundary materialised a racialised system of classification, ordering subjects by their professional and symbolic proximity to the aircraft. At the same time, *Solar Impulse 2*'s status as a prototype denied the coevalness of the mission and its promotional publics. The aircraft and its mission appeared as a demonstration of futurity and superior engineering, while the racialised crowds at Ahmedabad airport were stuck in the past, as passive, immobile recipients of foreign innovations, and witnesses to technological spectacle.

In Solar Impulse's communications, context was primarily identified with appreciative local crowds, mobilised as a promotional public to support of the mission's business-led message. A visible demonstration of the prototype vehicle's mobility and global reach, these crowds also provided a source of differentiation, distinguishing stopovers in Ahmedabad and Varanasi from those in Muscat, Cairo, or California. With limited opportunities for interaction with the ground crew or vehicle, the queuing crowds were marginalised; treated as an exotic, baseless backdrop for the vehicle's displays of virtuosity. Local context appeared again, this time as an obstacle, when the team sought to leave Ahmedabad. With a scheduled take-off delayed first by bad weather, a rescheduled departure was blocked by customs and immigration authorities. Impeding the spectacular mobility of *Solar Impulse*'s planned circumnavigation, this obstacle threatened its virtuosic projection of whiteness, prompting the crew to lash out at a reified colonial stereotype of India as a operational context shackled by regulation and bureaucracy.

In these cases, the role of context was revealed by the gaps and disjunctures encountered in each technology's movement between distinct operating environments. In the case of the 'New Roads in Varanasi' post, this gap was symbolised by linguistic difference. For *Solar Impulse 2*, the gap was rendered visible by a racial ordering enforced and systematised by a dividing 'colour line'. Alongside considerations of relative novelty and mutability, these examples show how enactments and appraisals of locality, mobility, and cultural, linguistic, or racial difference also shape different actors' delineations of context.

9.4.c. Worlding and context

Where delineations of infrastructures and their contexts often follow lines of relative locality, mobility, or obduracy, a greater attention to worlding shows how different actors' attributions of context can also be made *strategically*, in support of identified goals and priorities. Drawing on theories of practical ontology, in Chapter 8, I adopted a worlding lens, as an alternative to flat, homogenising accounts of the globalisation of infrastructure and urban development. By focusing on enactment over construction, and acknowledging the coexistence of multiple, jostling ontologies, I showed how actors' understandings of context not only vary, but can be critical for a given infrastructure project's ontological status. Where the same technology or infrastructure system can be differently worlded, with different actors' claims about relevant contexts coexisting despite their non-coherence, it follows that a given artefact's identity was not fixed. Instead, given sufficient effort and resources, a technology can be substantively *re-worlded*, with novel or distinct enactments of context capable of shifting its symbolic meaning and use.

In the first case from this chapter, an encounter between Pedal for Fun, a local recreational cycling group, and MYBYK's for-profit bicycle-sharing service provided a strategic site to investigate two distinct worldings of the bicycle. Pedal for Fun hoped to convince MYBYK's founder to lend some bicycles from their fleet for a charity bike ride. MYBYK's team had worked hard to promote the bicycle as a practical, utilitarian solution to a 'first and last mile' problem unaddressed by the city's existing transport services. For Pedal for Fun, by contrast, cycling was a recreational activity, to be enjoyed with others. Despite their differences, both groups sought to distance themselves from a dominant local perception, which stigmatised bicycle-use based on its association with a poor, low-caste user base. Timed to coincide with International Women's Day, the fundraiser provided these groups with a practical way to overcome this stigma, as the visible presence of Pedal for Fun's women members, and their appropriation of the city's road infrastructure, associated bicycle-use with a community acting to support a worthy cause.

In their efforts to present cycling as a modern, middle-class practice, Pedal for Fun and MYBYK's support relied on the Women on Wheels bike ride enacting two distinct, but overlapping, contexts. The first of these contexts was self-consciously 'global', linking the event with International Women's Day, and the global push for gender parity. The second context was 'local', using a common subject position as Indian 'women on wheels' to more

closely link the charity ride's young, middle-class participants with its beneficiaries; disadvantaged women retraining for work as professional drivers. Through the charity ride, the otherwise disconnected scenes of these recreational cyclists' weekend rides, MYBYK's fleet of green bicycles, the Women on Wheels training programme, and International Women's Day were able to intermingle, displacing the bicycle's stigmatised associations. The relevant contexts mobilised in this case were not determined by their relative obduracy, locality, or immobility, but were consciously enacted by the event's organisers, whose used them to advance their own long-term goals.

Where the Women on Wheels charity bike ride showed concerted efforts to re-world the bicycle, this chapter's second case extended a worlding lens to the redevelopment of Ahmedabad's Sabarmati riverfront. This development replaced a socio-ecological landscape that was previously home to 11,000 slum-dwellers with an ordered, 'world-class' space of parks, promenades, and high-value real estate. Dredging the riverbed to reclaim 162 hectares of new land for development, the scheme's developers invoked different contexts to overcome the resistance of the Sabarmati's existing landscape. Utopic visions of the reconfigured riverfront as a clean, ordered, and modern space, asserting Ahmedabad's global status, aligned the development with the needs of different stakeholders. At the same time, the planners designed the development to separate, relocate, or domesticate the situated practices of the space's existing users. Displacing slum-dwellers who had previously occupied the river's banks, the scheme set aside space within the parks and promenades to accommodate a popular, long-running bazaar, while relocating laundry-washing to a 'state-of-the-art' campus built at some distance downstream. By restricting and separating forms of difference at odds with the landscape's new global identity, the Sabarmati project's planners were able to enact the riverfront as a homogenous space, appealing to middle-class visitors.

Building on my experiences as an audience member at an evening celebration of the Sabarmati, hosted in Subhash riverfront park, and subsequent explorations of the then-incomplete development, several material details tracked how the Sabarmati project used worlding to achieve its goals. First, the use of gates and ticketed entry removed Subhash Riverfront Park from its immediate surroundings, enacting the space as a valued destination for visitors and tourists, rather than a local public amenity. Second, the presence of property and real estate hoardings showed how 'pinching' the river, and regularising its flow, created a distinctive, 'signature' context for investors and residents, and produced new plots of land, suitable for construction. Third, Subhash park's stepped

amphitheatre tracked how the space had been designed to serve as a venue for events, performances, and spectacle; an example of the strategic use of creative practices to 'revalorise' neglected, low-value urban spaces, through appeals to local culture and civil optimism. Finally, the inclusion of riverside promenades provided one immediately visible example of how the project's planners had mobilised world-class aesthetic benchmarks and appeals to the global to enact the riverfront as a blank slate, obscuring the contexts of its history and previous uses.

In these encounters, context was not a fixed or stable setting, but a resource to be mobilised. Scrutinising attributions of global and local descriptors, 'the global' was often cited as a relevant context, with indexing, mimicry, and circulation of best practices enacting an additional, albeit extra-local, operational context for cyclists, infrastructure planners, and the riverfront's users alike. Relevant actors found a wealth of symbolic resources in contexts as diverse as transnational feminism, leisure practices, philanthropic giving, gendered subject positions, flood resilience, modernity, tickets, the promises of a 'signature' view, history, local Gujarati culture, creative practice, and world-class aesthetics. The range and diversity of these worldings demonstrate context is neither static nor self-evident, external to the actors or projects under discussion, but deeply relational, emerging from the enactments and interactions of different relevant groups. This is particularly evident in the case of infrastructure, whose systemic, ontological, and experimental qualities mean they often overspill conventional contexts based on proximity or locale.

9.5. Making appropriateness

Typically addressing discrete technological artifacts, extending appropriate technology's critical posture to infrastructure requires some consideration. Though Willoughby argues 'appropriateness' can also apply to technological systems, so long as they can be 'contained' by the environment constituting their context. (Willoughby, 1990: 272), Recognising that contexts vary, accounts of appropriate technology claimed appropriateness was often the result of 'tailoring' a given technology to better meet local requirements. (Willoughby, 1990: 269) Once tailored, the technology would be considered stable. In this, calls for greater appropriateness supported a 'gentle negotiation' between technologies and their contexts, through iterative experimentation, tailoring, and adaptation. (Law et al., 2013: 182) This perspective does, however, presume a relatively

clear, stable relationship between a system and its environment. Such a treatment is rarely tenable, particularly when extended to infrastructure, whose contexts are neither static nor easily delineated.

One way of looking at such 'gentle negotiations' is through the lens of proximal design, which design researcher Svetlana Usenyuk and her colleagues coined to describe how user-designers have adapted technology to better suit its geographical and cultural setting. This is achieved either by modifying or improving received technologies, or else relocating design and production capabilities closer to the context of use. (Usenyk et al., 2016) Although proximal design's emphasis on user agency may seem like a generative starting point for discussions of appropriate infrastructure, there are a couple of problems. These derive from the concept's origins in research on mobility solutions in the Russian Far North—an extreme, peripheral environment, which often leaves standardised technology 'unstable, incomplete, and ill-defined' (ibid: 881). For those operating in settings that diverge from those imagined by designers and engineers, there is, Usenyuk argues, a need to close the distance between a technology's producers and its contexts of use. (Usenyk et al., 2016: 868) For users, such environments encourage the 'continuous tuning and modification' of a given technology, a 'making-appropriate' best undertaken in situ. (ibid.)

In practical terms, this might involve 're-opening' a technology through 'small mechanic alterations' (Usenyuk et al., 2016: 895), paralleling Kathryn Furlong's work on mediating devices (Furlong, 2011), and Monica Smith's account of infrastructural change as a sustained material 'conversation' (Smith, 2016). Alternatively, it could entail collecting, shaping, and combining 'distantly developed components' to create entirely new types of artifacts, often having also redefined one's own needs (Usenyuk et al., 2016: 895); a process resembling practices of bricolage or, in India, technological *jugaad*. (cf. Baker and Nelson, 2005; Sekhsaria, 2013; 2016; Kaur, 2016; Rai, 2019) In rare cases, appropriate technology can be produced by actors' determined to make full use of proximate materials and competencies to the exclusion of distant technologies, choices elevated as a normative good in *swadeshi* and Gandhian technopolitics. (Usenyuk et al., 2016: 895; Bakker, 1990)

Although proximal design's emphasis on user agency and practices of 'making-appropriate' is welcome, its explanatory limits are visible in attempts to extend the concept to research on informal settlements in South Africa. (Spinardi et al., 2020)

Relocated to this setting, it is easier to see how the concept's Russian origins promote a heroic, romanticised account of user design, while neglecting the shaping influence of social, economic, and political contexts. (Spinardi et al., 2020: 532) With structural constraints and trade-offs between different norms and values often precluding 'appropriate' outcomes, a greater attention to sociopolitical contexts can show how proximal design, where present, 'does not occur in a vacuum' (ibid: 533). In this, it is instructive to revisit the case of the Zimbabwe Bush Pump; a technology proximate to its users, and designed to be easily tailored to changing circumstances and 'local patterns of use and abuse.' (de Laet and Mol, 2000: 236) By diverging from familiar designs, such as those prevalent elsewhere in sub-Saharan Africa, the Zimbabwe Pump was separated from a 'stream of expertise' that had developed around the water pump sector, reducing opportunities for social learning—factors which, despite its other strengths, impeded the pump's long-term performance. (Borland, 2011: 207) In this, a pursuit of greater 'appropriateness' or context-sensitivity, likely comes at the expense of other qualities or advantages.

Examining these trade-offs and structural constraints prompts the question: appropriate—or inappropriate—*for whom*? To answer this requires recognising a given infrastructure's relevant actors include not just users and designers, but also engineers, contractors, investors, and politicians. Importantly, a greater emphasis on structure and actors beyond users need not support a singular focus on the heroic, privileged 'system builders' of earlier eras. (cf. Van der Vleuten, 2004; Ewertsson and Ingelstam, 2005; Jackston et al., 2007) Analogous to SCOT's pluralisation of relevant social groups[236], a pluralisation of infrastructure's relevant actors and contexts offers a way forward, with implications for mobilisations of 'appropriateness' as a normative good.

The interactions of these different contexts and actors can also explain the survival of inappropriate infrastructures, beyond simple appeals to their material obduracy. A particularly striking case can be found in Ralph Borland's work on the Roundabout PlayPump, a system using the energy created by children playing to operate a water pump, funded by advertising billboards attached to an elevated water tank. (Borland, 2011) Comparing unfavourably with the now-paradigmatic case of the Zimbabwe Bush Pump, the PlayPump is a clearly *inappropriate* technology, poorly suited to its sociocultural

[236] Consider, for example, how the conflicting priorities of engineers, architects, and an emerging working class exerted pressure on the implementation of Ildefons Cerdà's 1855 plan for the extension of Barcelona. (Aibar and Bijker, 1997)

context, and costing far more and accomplishing much less than its immediate alternatives. (ibid: 234)

As Borland describes, where elements of the PlayPump were well designed, it was to benefit an audience which selected the apparatus based on its ability to 'excite their imagination' and inspire support. blocking any further modification and, with it, opportunities for improvement and social learning. (Borland, 2011: 265) The PlayPump's iconic design and the perceptions of a majority-Western promotional public were deemed too important to risk permitting users' to reconfigure the system, even as this resulted in its failure. (Borland, 2011: 265) Ultimately, Borland reconciles the PlayPump's positive perceptions and practical failures by labelling it as a 'gratitude machine'; not a 'tool for the user to pump water, but … a tool for advocacy to first world audiences.' (ibid: 226) This example of ostensibly humanitarian design reaffirms the deeply unequal core-periphery relations connecting the ex-colonial West and the global south.

As in the PlayPump case, most users of infrastructure and urban space have limited power to resist decisions made at transnational, national, and municipal government levels, and few opportunities to promote their own alternative visions. Much as humanitarian design has had to address Western audiences and philanthropists before engaging with its intended beneficiaries, politicians and investors in postreform India have retained the power to advance projects by granting or withholding resources and support. Consider MYBYK's founders, for whom the withdrawal of political patronage created new obstacles and constraints for their service, despite positive public perceptions and a growing user base.

In urban India, this has created an environment where designs and future visions for urban infrastructure are addressed first to those with power and influence, often at the expense of a given development's supposed end users; a situation neatly satirised by the 'New Roads in Varanasi' post. Although exaggerations of a project's benefits can often harm users, and, consequently, its long-term success, the cost for more powerful actors of making such claims is usually low. (Borland, 2011: 277) At the same time, a fetishisation of novelty, modernity, and development, and the insulation of key actors from criticism, builds anticipation and expectations (cf. Larkin, 2013; Hetherington, 2017), while causing harms to the very people they ostensibly intend to benefit—whose voices and knowledge are excluded from planning and design. (Borland, 2011: 277)

Although an attention to structural forces, and the pluralisation of relevant actors and contexts, can help explain a given project's success or failure, these analytical approaches still hew closely to an ideal of context-sensitivity as something inescapably local, determined by proximity. In cases from the previous chapters, a context could be delineated by its proximity to a subject of interest, but this proximity was produced by the volume and density of relational linkages, rather than any stable, self-evident spatial or scalar categories. In this, a heuristic addressing mutability and mobility, alongside practices of worlding, showed context as an outcome of interactions between entities with differing degrees or manifestations of, for example, novelty, obduracy, locality, mobility, whiteness, or indigeneity.

9.6. Appropriate infrastructures?

Attention to mutability and mobility can pluralise infrastructure's relevant actors and contexts, while work on worlding practices reveals the contingency and normativity of claims about who and what counts. An interactionist reading of context can bolster relational accounts of infrastructures as open-ended ontological experiments; integrating actors, contexts, and other elements by spinning 'new relations' between them (Jensen and Morita, 2017: 617). In this, infrastructures are arenas where different kinds of agency encounter each other, and 'actors are given new form.' (ibid: 629-630) Though such an approach can accommodate both the heroic, Euro-American accounts of large technical systems and the 'splintering' of a once-dominant modern infrastructural ideal (cf. Hughes, 1983; 1987; Joerges, 1988; Ewertsson and Ingelstam, 2005; Graham and Marvin, 2001), it also encompasses a wider range of potential subjects and phenomena; ratcheting open the possibility space, with fewer fixed or prescriptive criteria about what to include or exclude.

If appropriateness is a question of relational proximity, and infrastructures are a kind of ontological experiment, the coupling of appropriateness and infrastructure does a certain kind of work. This is not the work of the specific-characteristics version of appropriate technology; a checklist requiring assessments of a given system's flexibility, repairability, cost, or the relative balance in its demands of capital and labour. (Willoughby, 1990) Instead, following a general-principles approach, the 'appropriate' qualifier highlights infrastructure's instrumentality, targeting certain specified outcomes. In this, appropriate infrastructure can do three things. Firstly, it critiques incumbent, often

'inappropriate', infrastructure projects. Secondly, a close attention to proximate contexts creates opportunities for a two-way, lateral, and intercultural traffic in concepts, cases, and practical knowledge. (cf. Boyer and Marcus, 2015) Lastly, it redresses a neglect of the needs and contexts of users and consumers, privileging these over those of other actors, while drawing attention to exclusionary practices and structural barriers to access.

Firstly, invocations of 'appropriate infrastructure' operate as a critique of dominant understandings of infrastructure. Where constructivist theories of technology begin from the recognition that 'things could have been otherwise' (Bijker, 1997: 280), appropriate technology critiques took this a step further, challenging those who believe the present state of any given set of circumstances to be 'either inviolable or optimum.' (Willoughby, 1990: 294) For proponents of these practical knowledges, the argument was not just that things could have been different, but that they *still* could, and that it might be a good thing if they were. For intermediate technology, this critique opposed largely failed efforts to accelerate industrial development in former colonies through the transfer of capital-intensive technology from the metropolitan core. Opposing British colonial rule, the *swadeshi* movement stressed the role of local self-reliance, favouring indigenous technologies and local economies. (Arnold, 2013: 18) Grassroots innovation rebuffed a portrayal of rural India as a sink for aid and advice, sourcing sociotechnical solutions from villages marginalised in hegemonic innovation discourse. (Irani, 2019: 6)

A comparable critique of infrastructure can be seen in the 'New Roads in Varanasi' Facebook post, and cartoonist R.K. Laxman's caricatures of infrastructure-led development. But where these satirical images operated in a critical mode, supporters of appropriate technology have blended theory and practice, reconfiguring and re-worlding existing technologies to better support their aims and values. In different ways and at different times, intermediate, *swadeshi*, and grassroots technologies offered alternatives to top-down programmes of resource extraction, indexed against Western historical experience.

The 'appropriate' modifier problematises infrastructure, implying that many existing examples may be inappropriate to their contexts of use. As a problematising move, invocations of appropriate infrastructure reflect a wider 'refuge in adjectives', following the eclipse of more explicitly 'critical nouns' derived from, e.g., Marxism and critical theory in the 1990s-2000s. (Santos, 2014: 34, 33) As sociologist Bonaventura de Sousa Santos describes:

> Adjectives may subvert the meaning of nouns. … On the other hand, we must bear in mind that nouns establish the intellectual and political horizon of that which is sayable, credible, legitimate, or realistic and, by implication, of that which is unsayable, incredible, illegitimate, or unrealistic. (Santos, 2014: 34)

Such adjectival subversions can be found across the global south, in 'non-Eurocentric renditions of Eurocentric concepts', such as communitarian democracy, grassroots innovation, or the plurinational state. (Santos, 2018: 9) In a similar way, alternative and intermediate technology have sought to construct hybrid, critical renditions of hegemonic technology. Intermediate technology and grassroots innovation have made creative use of 'conceptual franchising', while conceding the need to present their arguments and proposals within a 'horizon of possibilities' that is, at least initially, not their own. (Santos, 2014: 34)

Secondly, appropriate infrastructure can provide a foundation for intercultural translation or hybridisation, bringing alternative practical knowledges and non-Western analytical resources to bear on processes of urban sociotechnical change. (cf. Gad and Jensen, 2016a; Law and Lin, 2017) Reconciling universalising conceptions of modernist infrastructure with the fissures of cultural relativism, there is a need to support 'cross-cultural dialogues on isomorphic concerns', while developing procedural tools to distinguish goods from bads. (Santos, 2007: 14) In practical terms, this could involve setting Indian or South Asian terms of analysis alongside Euro-American accounts of infrastructure and urban change; facilitating a 'lively, two-way, and contested' traffic in local and culturally embedded analytical resources.[237] (Law and Lin, 2017: 214) This need not be motivated by curiosity or dilettantism, but instead, as Santos argues, follows the 'need to broaden political articulation beyond the confines of a given locale or culture.' (Santos, 2014: 214) In research terms, this might involve thinking across relevant cases and encounters, using comparison to identify certain transparticular linkages and resonances. Invocations of appropriate infrastructure could be a way for different actors to mobilise useful concepts, 'for experimental use elsewhere.' (Boyer and Howe, 2015: 37, 31)

Pursuing intercultural dialogue, these efforts might best use the 'appropriate' modifier to characterise and affirm 'efforts that are ongoing, adaptive, … and open ended.' (Heuts and Mol, 2013: 130) With user needs and structural pressures varying over space and time, the most effective way to move towards the good is through tinkering,

[237] Consider, for example, how India's *swadeshi* movement remains largely unfamiliar to Western audiences, even as its histories prompt important questions about relations of autonomy, sovereignty, dependence, and control.

experimentation, and social learning. (cf. Dourish, 2004; Jensen and Morita, 2015; 2017) In this, the pursuit of appropriate infrastructure as an index or ideal would not involve 'taking control and imposing an ideal, but … playing with possibilities, while staying attentive to what is good.' (ibid: 139) Reconciled to non-coherence, heuristics of mobility, mutability, and worlding could sensitise future analyses to the contingency of context. Such a heuristic would prompt actors to ask what it would mean to be 'appropriate', attending to a range of relevant contexts, in particular circumstances, and how this might vary. In practical terms, the population of these and similar such frameworks could be adopted as an exercise preceding, or running alongside, experimental interventions, and more pluralised practices of planning, assessment, and deliberation.

Third, and lastly, appropriate infrastructure foregrounds questions of consumption and use, advocating for a greater weighting of users' needs relative to those of other actors, and spotlighting the separation of users from non-users, through barriers to access. Despite the weaknesses of theories of proximal design (Usenyuk et al., 2016), and ideologically loaded accounts of the intrinsic ingenuity of India's 'common man' (Kaur, 2016), representations of India's infrastructure users as passive recipients risk occluding their agency, and the material effects of their worlding practices. Accounts of technological *jugaad* (cf. Sekhsaria, 2013; 2016; Rai, 2019) and more recent institutional support for grassroots innovation (cf. Smith et al., 2017) demonstrate the need to move beyond simple oppositions distancing heroic innovators from their 'consuming and labouring others.' (Irani, 2019: 15) Neither passive beneficiaries of development, nor rational, atomised, self-maximising consumers, these users have intervened to extend, supplement, and modify existing infrastructural systems, acting collectively[238], and through material conversation (cf. Smith, 2016), in ways that trouble clear delineations of authorship and individual agency.[239]

Where the modern infrastructural ideal pursued universal service coverage within a given territory, catering to a mass user base through standardised monopolies (Graham and Marvin, 2001), service provision in urban India has long been splintered. (cf. Coutard, 2008) In contemporary Indian cities such as Ahmedabad:

[238] For example, by mobilising their collective electoral influence to press politicians to extend access to services, and formalise infrastructural connections and land tenure claims. (cf. Benjamin, 2008; Shatkin, 2017)

[239] See Chapter 6, on the disavowal of human responsibility for the growth of roadside shrines (Ghassem-Fachandi, 2012; Larois and Vois; 2018); p. 121.

> Labor migrations, regional disparities, deregulation, complex political formations, globalized assemblages of value extraction (from supply chains to risk assessments to financial derivatives), and rapid, sprawling urbanization [result] in at times volatile but increasingly synergistic mixtures of transnational and indigenous capital, hybrid labor formations, and sharpened, often violent social and economic antagonisms. (Rai, 2019: 136-137)

In this complex, uneven urban landscape, the allocation and extension of infrastructural services, such as roads, sewers, streetlights, and water sources is often highly politicised, requiring users to engage with intermediaries and their networks. (Auerbach et al., 2022: 255) At the same time, the introduction of entry fees and ticketed access, as seen at Subhash Riverfront Park[240], speak to new dynamics of exclusion through class capture, as planners and politicians enable the monopolisation of public space by an increasingly influential urban middle class. (cf. Mehta, 2018) As such, any invocations of appropriate infrastructure must not only has to address users' interventions and modifications, but also the role of brokers and intermediaries in facilitating access to services, alongside structures and systems of exclusion.

In sum, a hybrid concept of appropriate infrastructure, as introduced here, could unsettle the components of dominant, Euro-American conceptions of infrastructure, indexed against a modernist ideal. The 'appropriate' adjectival modifier supports a pluralisation of relevant actors and contexts, creating space for a two-way traffic in practical knowledges, while directing researchers and practitioners' attention to current and would-be users, their relevant contexts, and any obstacles to access and use. In this, the concept tracks analogous concepts of appropriate technology, as a practical knowledge providing grounds for action. Hewing closer to the general-principles approach to appropriate technology, rather than stipulative checklists of specific-characteristics (Willoughby, 1990), it is difficult to operationalise appropriate infrastructure as a criterion or rubric for appraisal. Despite these limitations, however, the concept is favourably positioned to support researchers and practitioners, as a prompt, sensitising concept, or heuristic for decision-making.

[240] See Chapter 8; pp. 212–214.

9.7. Discussion

This chapter extended my analysis of the mutability, mobility, and worldings of urban infrastructure, assessing its normative implications and treatments of context. Reflecting on the value and utility of 'appropriateness' as a quality of urban infrastructure projects, I began by examining the role and presence of normativity and appraisal in STS, mobilising Annemarie Mol's coinage of the ontonorm to explore stances of objectivity, criticality, and interpellation. (cf. Mol, 2012) Next, I turned to appropriate technology, a broad concept gathering a range of practical knowledges, whose forms and foci have varied across settings and over time. Where most accounts of appropriate technology have focused on its manifestations in post-war Europe and the United States, my work on infrastructure and urban development in post-2014 India saw me turn instead to E.F. Schumacher's work on intermediate technology, India's anti-colonial *swadeshi* movement, and the Honey Bee Network's efforts to support indigenous grassroots innovators. Moving beyond a stipulative approach to appropriate technology, these practical knowledges approached appropriateness in more general terms, offering heuristics for action over of a checklist of qualifying criteria. This approach showed greater relevance for my own analysis, proving more easily extended to infrastructure and urban development projects.

Examining these knowledges' different approaches to appropriateness, I compared representational and interactional interpretations of context—reflecting on how the previous chapter's emphases on worldings and enactment supported the more relational, interactionalist approach. Treating context as something people *do*, a local outcome of social practice, with tangible and material effects, supported an understanding of contextualisation as a political act, requiring the would-be contextualiser to address normative questions of who and what matters. Next, I approached context and contextualisation through my own heuristic of mutability, mobility, and worlding. Revisiting cases and encounters from the previous chapters, I showed how delineations of context could turn, variously, on relations of stability, novelty, mutability, mobility, or locality. At the same time, different sets of actors used attributions of context, and assertions of global or local identity, as a symbolic resource, deployed strategically to further their goals.

In the final part of this chapter, I outlined some contours and potentialities of appropriate infrastructure, envisaged as a hybrid concept analogous to appropriate technology. Approaching contexts as neither stable nor self-evident, but the effect of a

density of relational interactions, the selection pressures of structural constraints and trade-offs between appropriateness and other values prompted a further question: 'Appropriate *for whom*?' Responding to this question with my own, synoptic sketch of appropriate infrastructure, I showed how this could effectively critique existing 'inappropriate' infrastructures. As a frame holding across settings and regions, advocacy for 'appropriate infrastructure' could, I argued, hold space for an increased traffic in concepts, cases, and practical knowledge, while supporting a commensurately greater weighting of users' needs over those of other actors.

Chapter 10: Conclusion

10.1. Introduction

This study has focused on infrastructure and urban change in mid-2010s Ahmedabad. I applied concepts of mutability, mobility, and worlding to explore the relations between infrastructure and urban development projects and their multiple contexts. As visible emblems of development, such projects in India are increasingly subject to a majoritarian, Hindu nationalist political and ideological context. (cf. Jaffrelot and Verniers, 2020; Manor, 2021) Presenting cases and encounters drawn from observational research conducted in Ahmedabad between 2015–16, this thesis examined different technology, infrastructure, and urban development projects active in and around the city at this time. My analysis focused on where and when these projects proved mutable or obdurate, able to adjust to the pressures and constraints of their setting, or else resisted reconfiguration—even when doing so risked undercutting their success.

After introducing the study, Chapters 2 and 3 ('Infrastructure and sociotechnical change', 'Mutability and mobility') established a theoretical foundation for my research, reviewing existing academic literature on infrastructure, urban change, obduracy, mutability, mobilities, and the domestication and appropriation of technology. Chapters 4 and 5 ('Locating Ahmedabad', 'Sociotechnical *flânerie* in the postcolonial city') introduced my field site and research methods, discussing Ahmedabad's spatial features and historical experience, and reflecting on the challenges of adapting single-sited ethnographic research designs to work on large, networked infrastructures and urban sociotechnical change. I identified a useful reference point in Walter Benjamin's writings on *flânerie*, breaking down its component practices of walking, observation, knowledge production, and textual authorship, and explaining how these could be reworked to support a focus on sociotechnical subjects in postcolonial urban space. An interlude, 'Assembling whiteness', reviewed research treating race through an assemblage lens; with implications for the operations and effects of my own whiteness as a researcher, and that of many infrastructure projects in urban India.

In Chapters 6, 7, and 8 ('Mutable infrastructures', 'Mobile infrastructures', 'Worlded infrastructures'), I threaded encounters from my research, comparing these examples and

other published cases, to extend and challenge existing accounts of mutability, mobility, and worlding. As anchors for a three-part heuristic framework, I showed how these conceptual frames could support analyses of infrastructure and its contexts. Prior to reflecting on the study's normative implications, a second interlude ('Bungalow No. 1. to Rashtrapati Bhavan') detailed my interactions with the volunteer-staffed Honey Bee Network and its associated organisations, examining their scouting activities and support for Indian grassroots innovation practices. Chapter 9 ('Appropriate infrastructures') reflected on 'appropriateness' as both a quality of infrastructure and urban development projects, and a norm or criterion for appraisal. Referring to previous and existing appropriate technology practices, and their different conceptualisations of 'context', this chapter concluded with an outline of 'appropriate infrastructure.' Supporting a pluralisation of relevant actors and contexts, this concept attends more closely to infrastructure's users, and any barriers to access or use.

In the rest of this concluding chapter, I revisit my original objectives, looking at what conclusions can be drawn from the cases derived from my *flânerie* in Ahmedabad. Next, I consider the study's contributions, identifying some wider implications of this coupling of theory, descriptive material, normativity, and methodological techniques. Then, I identify some academic conservations and communities of practice that my research can contribute to. Finally, I conclude my briefly discuss more recent developments with salience for infrastructure and urban development, in India and elsewhere.

10.2. Project findings

Returning to the introduction, the first of my research questions asked about the factors contributing to the success or failure of infrastructure projects, and how such projects adapt to, or face resistance from, their contexts of implementation. In this, a focus on mutability (Chapters 3 and 6) revealed how a given system's amenability to reconfiguration is not simply a result of its material properties. Instead, crosscutting relations of fixity or fluidity are also affected by social, religious, and political constraints, user practices, and dominant cultural perceptions and hierarchies of value. Furthermore, mutability is not the sole determinant of a given infrastructure or urban development's success. Focusing on worlding practices and invocations of context, Chapter 8 showed how different relevant actors can have divergent understandings of success or failure. One illustration of this can be seen in the case of the Sabarmati riverfront development, where

planners facilitated the eviction and displacement of the space's original users, to create a landscape catering to the desires of the city's new middle classes. As in Chapter 9, the influence of less proximate actors, such as funders or politicians, can create powerful selection pressures for infrastructure and urban development projects—shaping details of design and operation that can undercut their long-term efficacy, adaptability, or ability to accommodate users' needs.

Although mutability is not the sole determinant of an infrastructure project's success, the case of Ahmedabad's Janmarg Bus Rapid Transit system shows it plays an important role. Adopting a transport model already familiar to mnay users, a staggered, multi-stage rollout created opportunities for experimentation and social learning, as early encounters with social and material resistance saw modifications made to the project's plans and designs. These changes yielded to user preferences and the configuration of busways and supporting elements, but also, elsewhere, to elements of the built environment, with existing infrastructure and culturally significant structures resisting relocation. In this case, Janmarg's mutability appears as a normative good, improving its capacity to respond to resistance prompted by its implementation, and forces inhering to its proximate environment. Janmarg's supporting infrastructure also provided a base for the MYBYK bike-sharing service, which was able to extend the bus system's capabilities by offering a solution to the difficult 'first and last mile problem'.

My second research question introduced the idea of 'appropriateness', asking whether it was a useful analytic or normative criterion for urban infrastructure projects. At an analytical level, there is a risk of tautology here, equating appropriateness with success and inappropriateness with failure. By pluralising relevant actors and contexts, as recommended in Chapter 9, it is possible to see how a particular project can be a success for its funders or political supporters, while acting against the interests of users or other stakeholders. These dynamics were visible in the Sabarmati riverfront case, for example, and help explain the hard limits encountered by MYBYK's founders as they attempted to grow their business.

Contrasting 'appropriateness' with more frequently cited norms of efficiency, sustainable development, social justice, resilience, or maintainability (cf. Sovacool and Hess, 2017) suggests appropriateness is less effective as a description or stipulative norm than a heuristic. Exploring different understandings of 'appropriateness' in appropriate technology, Chapter 9 demonstrated how the concept serves as a counter-hegemonic

critique, justifying a greater attention to a given technology's relations with its relevant settings and contexts of use. These contexts are rarely stable nor self-evident, based on clear spatial or scalar criteria (such as watersheds, linguistic communities, etc.). Instead, they are products of practical ontology, enacted by different actors, but following the relations between a given system and its social and physical surroundings. In this understanding, relational proximity need not denote spatial or geographical proximity. For example, the 'global' appears as a relevant context in many of the cases featured in Chapters 6-8, through appeals to 'world-class' standards or aesthetics, or models indexed against some global ideal.

Ultimately, committing to an interactional understanding of context (cf. Dourish, 2004) makes it difficult to operationalise appropriateness as a criterion for appraisal. Contextualisation becomes a contingent and normative move, requiring judgements about who and what matters. As discussed in Chapter 9, it therefore makes more sense to consider appropriateness as a matter of 'general-principles' than 'specific-characteristics' (cf. Willoughby, 1990). In practical terms, it is more useful to position appropriate infrastructure as an alternative to dominant visions of well-ordered, unitary cities and standardised, territorial infrastructure monopolies. (Graham and Marvin, 2001) As a critique and sensitising concept, rather than a stipulative criterion, appropriate infrastructure recognises that what constitutes or qualifies as 'appropriateness', as a general principle, will vary over space and time.

The third set of questions introduced considerations of validity and generalisability, commonly held up as characteristics of 'good' social research. Balancing the general (theoretical claims) and the particular (descriptive cases and encounters), these normative criteria have less value for *flânerie* and abductive analysis, which rely on inferences from subjective, partial data to produce novel insights and reframe existing findings. (Timmermans and Tavory, 2012; Tavory and Timmermans, 2014) A more useful criteria is *transparticularity*, as introduced by anthropologists Dominic Boyer and Cymene Howe. This involves looking at how particular cases or encounters speak with others, operating as a 'cryptological key to a large set of information' (Boyer and Howe, 2015: 16).

As discussed in Chapter 5, this study aimed to produce faithful accounts of first-hand encounters (cf. Zeitlyn, 2009) that could be of some use to academic audiences, and communities of proximity and practice. This requires making contributions to discourse, setting stories into circulation or 'wrest[ing] away from a case study the cluster of insights

… worth mobilising' (Boyer and Howe, 2015: 16-17), but also, as in my outline of appropriate infrastructure, providing heuristic frameworks to steer decision-making. In either case, mobilising insights requires a sensitivity to prevailing contexts, and the explanatory limits of generalisable theory.

In this study, there are questions both about the specificities of undertaking research in Ahmedabad at this point in the mid-2010s, and, more broadly, the distinct characteristics of infrastructural systems, urban spaces, and postcolonial settings. Although I avoided presenting Ahmedabad as a metonym for urbanisation in India or the global south, details of the city's social and political configurations can illuminate something of the politics of infrastructure in the early twenty-first century. In the spatial and temporal contexts of Ahmedabad and 2010s India, infrastructure and urban development projects have been mobilised by a political regime operating at city and state scales, re-worlding the city to facilitate capital investment and meet the aspirations of a youthful, urbanising 'neo-middle class' (Jaffrelot, 2013). In this setting, urban infrastructure is at once fetish and political signifier, standing as tangible evidence of development and modernisation. To overgeneralise from Ahmedabad's experience, however, would neglect the role the city has played as a laboratory of Hindutva politics, with policy strategies piloted in the city and Gujarat state later scaled to the level of the nation.

In considering the differences between urban infrastructure systems and technological artifacts, the explanatory limits of constructivist theories are particularly visible in attempts to extrapolate from, e.g., SCOT. Where relatively small, self-contained technologies travelled from the metropolitan 'core' as fixed objects with self-evident benefits, infrastructure's systemic character demands active translation and practices of making-appropriate. These adjustments are even more important in urban settings, whose proximate contexts are likely to encompass existing infrastructural systems, and elements of the built environment. Challenging the modern ideal, which promoted an image of designed, planned technical systems, accounts of tailoring and adjustment highlight the open-endedness of infrastructural relations, as integrating multiple, often contradictory elements, and enacting distinctive new contexts and patterns of sociotechnical change. (cf. Jensen and Morita, 2015; 2017) Far from immutable mobiles, infrastructures, once installed, are typically immobile. In addition, they demonstrate degrees of fluidity and stickiness. (cf. Scott-Smith, 2018) Even when they start as subjects of technology transfer, these experiments settle into locally distinct singularities, participating in the call-and-

response material dialogues described by archaeologist Monica Smith. (Smith, 2016) They may fail to serve their users or meet their planners' original goals, or be rendered obsolete by changing circumstances, but they rarely break—at least, not outright, or all at once. (cf. de Laet and Mol, 2001)

The highly visible, often spectacular presence of infrastructure and urban systems in Ahmedabad parallels similar accounts from postcolonial cities elsewhere in the global south (cf. Namba, 2017), undercutting presumptions of invisibility. (cf. Star, 1999) In these contexts, infrastructure is not naturalised as an inert backdrop to everyday life, and may assume greater cultural and symbolic significance. With profoundly unequal colonial power relations having shaped urban development and configurations of service provision, this ideal often appears as an absent presence, indexing development and modernity against post-war, Euro-American norms. (Graham and Marvin, 2001) At the same time, Ahmedabad's position as a trading hub with few proximate natural resources, linking a north Indian hinterland with the Indian Ocean, allowed local elites to maintain a certain autonomy. This mercantile elite was able to modernise the city on its own terms, mobilising their wealth to commission bold new buildings, fund outward-looking institutions, and import knowledge and expertise from Europe and North America. (cf. Nanda, 1994; Raychaudhuri, 2001; Bekkers, 2005; Chandrani, 2013)

Although this makes it difficult to generalise more widely from Ahmedabad's experience, the city's governing elites nonetheless maintained their power through their close interactions with colonial authority, as active participants in a racialised pigmentocracy that valued proximity to whiteness, while seeking distance from denigrated lower and backward castes. (Dhillon, 2015) In mid-2010s Ahmedabad, similar racialised dynamics could be seen in efforts to emulate 'world-class' aesthetics in infrastructure and urban space, the aspirations of an urban middle class seeking to participate in global leisure practices, and local perceptions of cycling as stigmatised by its association with a poor, low-caste user base. While these colonial and racial dynamics diverge from those encountered elsewhere, a greater sensitivity to the role of race and racialisation in infrastructural relations, particularly those associated with histories of indirect or proxy rule[241], could offer a frame for future comparison.

[241] See, for example, Brian Larkin's work on Kano, in Nigeria. (Larkin, 2008a; 2008b)

10.3. Primary contributions

This project makes three primary contributions, on theoretical, normative, and methodological grounds. Configured to support this study of infrastructure and urban development in Ahmedabad, these contributions could nonetheless be decoupled, with different elements taken and adapted for reuse elsewhere.

10.3.a. Mutability, mobility, worlding

The first of these contributions is theoretical, with a three-part heuristic of mutability, mobility, and worlding prising apart the different elements of Bruno Latour's notion of the 'immutable mobile' (Latour, 1987). Supplementing an analysis of how given subjects maintain their shape and identity, or fail to do so, as they move between settings, the coupling of these concepts also poses questions about the fixity of technologies' symbolic and cultural meanings, and enactments of different 'propositions about context' (Tsing, 2010: 49). Providing thematic tentpoles for the three main empirical chapters, this heuristic is not an conceptual account of sociotechnical change, standing alongside those introduced in Chapter 2 (i.e. SCOT, LTS, the MLP). Nor is it one of the totalising grand theories that furnished the 'critical nouns' of an earlier era. (Santos, 2014: 33-34) Instead, my couplings of mutability, mobility, and worlding follow concepts as they move sideways across cases, forging connections 'across time, discipline, community, and place.' (Wyatt and Balmer, 2007: 622) Flipping between cases and concepts, these frames allowed me to identify and elucidate points of similarity and difference, as 'analogies and contrasts' (Candea, 2019: 196).

Mutability, mobility, and worlding are sensitising concepts (Blumer, 1954), suggesting directions for inquiry, and capturing the 'transparticular linkages and resonances' between different phenomena. (Boyer and Marcus, 2015: 7) As building blocks of middle-range theory (cf. Merton, 2012 [1949]; Wyatt and Balmer, 2007), these concepts are 'more than a case study' but 'less than a generalisation' (Candea, 2019: 140). They also serve as correctives, capable of 'shooting holes' in categorical essentialisms, and a series of lenses, facilitating the 'simultaneous focusing or rapid refocusing on different perspectives.' (Wyatt and Balmer, 2007: 622-623) Mutability and obduracy showed the explanatory limits of constructivist theories of the stabilisation and closure of technology. A focus on mobility provided a way to push back against received models of frictionless,

point-to-point technology transfer, and diffusionist theories of innovation. Theories of worlding unmasked triumphalist accounts of the globalisation of urban infrastructure as but one possible enactment among many.

Although this three-part heuristic provided a scaffold for my research on infrastructure and urban change in mid-2010s Gujarat, this same combination of concepts could be productively applied elsewhere. As one practical example of techniques of frame formation and dissolution common in lateral theory (Howe and Boyer, 2015), this or similar such heuristic frameworks could be a useful foundation for work on any number of infrastructural or urban topics. Notions of mutability and mobility could support research on different actors' attempts to steer urban transformation, and the implementation of infrastructure projects modelled on examples already active elsewhere. As in my own work, a focus on worlding is well-suited to tracking the symbolic meanings and extra-functional effects of artifacts, infrastructures, and technological artifacts, demonstrating how different groups can shift apparently fixed cultural associations and, with them, conditions of use.

10.3.b. Appropriate infrastructure

My work on appropriate infrastructure represents a second contribution. Diverging from earlier, 'specific-characteristics' approaches to appropriate technology (cf. Willoughby, 1990), appropriateness appears here not as a categorical quality of infrastructure, or a criterion for evaluation. Inspired by earlier, situated practical knowledges of appropriate technology, which pursued alternative and counter-hegemonic values in their assessment of technological choices, I outlined 'appropriate infrastructure', a portable analytic intended to disrupt and trouble hegemonic, modernist conceptions of infrastructure. Creating a foundation for intercultural comparisons, this concept asks what appropriateness means, in specific terms, and how this varies across different settings and situations. Reflecting on the structural constraints and trade-offs shaping different infrastructure projects, appropriate infrastructure also suggests a greater attention to context is unlikely to be a sufficient guide for action, with plural contexts making different, often contradictory demands. Mobilised alongside other values and normative criteria, such as resilience and sustainability, 'appropriateness' supports weighting the needs and contexts of end-users over those of other actors, while remaining vigilant to exclusionary practices and barriers to use.

In my own work, appropriate infrastructure highlights the inappropriateness of many projects and developments undertaken under the auspices of the 'Gujarat model', which served the interests of political actors, investors, and an imagined middle class over many of their ostensible beneficiaries. (cf. Sud, 2022) The same concept could be extended to research on infrastructure and urban development in other settings, with its relational understanding of context and pluralisation of relevant actors well-suited to research on, e.g., urban heritage, smart cities, renewable energy infrastructure, or digital mobility platforms. This sketch of 'appropriate infrastructure' could also serve as a guide or heuristic for practitioners, supporting a more affirmative, pro-active mode of critique. This might eschew often bureaucratic processes of appraisal and evaluation in favour of something closer to an ethic of care. In practice, it could resemble what Anand Pandian describes as 'tending an open horizon'; identifying and fortifying existing examples of more-appropriate infrastructure, as a way of working 'in collaboration with potentials already in the world' (Pandian, 2019: 119).

10.3.c. Sociotechnical flânerie in the postcolonial city

A third and final contribution is methodological, following my adaptation of the component practices of *flânerie* to better facilitate research on sociotechnical subjects, and accommodate the distinct features of postcolonial urban space. Using walking and mobile observation to 'read' the city, its population, and spatial configurations, *flânerie* supports interpretive and abductive forms of inquiry, providing an alternative to long-term, ethnographic participant-observation. Abductive approaches set out to generate fresh theoretical insights, through the creative exploration of alternative hypotheses. (Timmermans and Tavory, 2012: 180, 169) Using thick description to provide the situational context and details required for interpretation, *flânerie*, like ethnography, seeks to produce faithful accounts of identified phenomena from subjective, partial data. (Zeitlyn, 2009) Unlike ethnography, *flânerie* remains relatively detached from its subjects and interlocutors, and more open to 'poetic suggestions' (Nuvolati, 2014: 25), pursuing 'small epiphanies' (Trivundža, 2011: 75) over holistic accounts of a community of proximity or practice. It also draws readily on practices of polymorphous engagement (Gusterson, 1996), supplementing mobile observations with a mix of other research techniques and strategies, including interface ethnography, interviews, and media analysis.

In its original, nineteenth-century guise, *flânerie* responded to the need to depict and represent the transformations and turbulence of Europe's then fast-expanding cities, tracking the emergence of a 'new commodity culture' and the resulting urban crowds. (Barker et al., 2013: 162-163) Articulating the method's original component practices of walking, observation, knowledge production, and textual authorship, I showed how these might be reworked to support sociotechnical subject matter and novel contexts of application. Though some argue Benjamin's writings apply equally to the postcolonial city, a direct transplantation risked eliding the differences between, e.g., nineteenth-century Paris and contemporary Ahmedabad. Duly relocated, my attempts to operationalise *flânerie* had to reckon with urban spaces shaped by colonial dynamics of separation and subjectification, through regimes of surveillance, policing, hygiene, and similar. (Varma, 2012) Even Ahmedabad, which escaped the worst excesses of British rule, is a built environment bearing the material traces of such dynamics, which facilitated the reallocation of access and resources between colonisers and colonised.

In my research, practices of walking and mobile observation were complicated by my whiteness, which prevented me from melting into the crowds. Marked as a stranger, my subject position mediated my experience of the city, affecting the places I could access, and the kinds of knowledge I could produce—requiring a closer attention to reflexivity, processes of subjectification, and moments of 'disconcertment' (Verran, 2001). This also demanded an attention to how my acculturation shaped the theoretical tools I had 'to hand'; a 'socially located, positional knowledge' that manifested in best guesses and intuitive leaps, as seen in those experiences of disconcertment, where my expectations collided with a recalcitrant reality. (Timmermans and Tavory, 2012: 172) Remaining sensitive to the enduring influence of colonial discourse, tropes, and stereotypes (cf. Spurr, 1993; Pratt, 2008; Said, 1979), my descriptive texts sought to makes sense of a dynamic, fragmented urban experience without falling back on Orientalising essentialisms, binary oppositions, or hierarchies of value indexed against Euro-American ideals.

An adjusted sociotechnical *flânerie*, regardless of its context of application, is well-suited to research on infrastructure and urban development, supporting work on the layering and interplay of different urban systems, and how material objects track processes of sociotechnical change. (cf. Pusca, 2008; 2009) Equally, *flânerie*'s emphasis on techniques of mobile observation could easily support research on the lived experience of transport and mobility, and infrastructural systems facilitating movement within the city. In my case, this entailed a greater prominence for the role of the auto-rickshaw, as a

locally prevalent mode of paratransit, with its own symbolic and cultural significance, but this could equally support work on e.g. cycling infrastructure, India's urban metro systems, or the uptake of a new generation of electric vehicles.

10.4. 'Splintered' cities and infrastructural stigma

Having discussed my study's overall contributions to knowledge, in this section, I identify two further academic conversations in infrastructure and urban studies. Using these to address some additional implications of my research for academic audiences, I highlight emerging themes of interest and generative areas for future research.

The first such conversation responds to the 20th anniversary of urban geographers Stephen Graham and Simon Marvin's *Splintering Urbanism*. Contributors took this as an opportunity to reflect on the book's impact, with it having played a central role in a so-called 'infrastructural turn' in social science and the humanities. (Graham and Marvin, 2022: 172-173) Although my own study used these authors' accounts of 'failed attempts' to cultivate a modern infrastructural ideal, I paid less attention to their arguments about the 'splintering of public space and provisions', and the resulting—often neoliberal—'unbundlings' of infrastructural service in the contemporary city. (Wiig et al., 2022: 2) Relocating this notion of urban 'splintering' to South Asia and sub-Saharan Africa, in this section, I summarise the contributions of geographer Malini Ranganathan, who mobilises the concept to illuminate the production and reproduction of caste relations in urban India, and urban researcher Prince Guma, who draws on his research in Nairobi to rehabilitate splintering as a generative incompleteness. (Guma, 2022)

The second academic conversation responds to my earlier concern with obstacles to infrastructure access. Contributors address tangible physical and material barriers, but also extend the frame to encompass vulnerability, precarity, and urban stigma. (Baumann and Yacobi, 2022) This shifts the focus from production to consumption, highlighting more slippery, diffuse barriers to use. In urban India, such obstacles are often linked to differences of race, caste, and religion, as further articulated through a 'bimodal' distribution of urban infrastructure services. (Gopakumar, 2020) Empirical research on environmental stigma (Pleuckhahn, 2022) and de-stigmatisation strategies (Allen, 2022) develop this conversation, suggesting productive directions for future research.

Read together, these two conversations highlight race and caste as factors complicating any further mobilisation of appropriate infrastructure in urban India. They also supplement and further reframe my discussions of the whiteness of certain infrastructure, technology, and urban development projects. In the final part of this section, I bring the two conversations together, reflecting on how heuristic lenses of mutability, mobility, and worlding might be extended to the 'caste-splintered' city—and with what implications for de-stigmatisation strategies, counter-caste practices, and further research on infrastructure and urban change.

10.4.a. 'Splintered' cities

First published in 2001, *Splintering Urbanism* bridged previous work on infrastructure, typically dominated by voices from engineering and policy, and critical urban research. (Graham and Marvin, 2022: 169) In the 20 years since its publication, there has been an abundance of research on infrastructure; what it *does,* its 'differential and uneven' effects, productions, and performances, and how these embody and mediate economic and political power. (Wiig et al., 2022: 4) But even though it is how the book has often been interpreted, authors Graham and Marvin did not intend to argue that all cities were becoming 'little more than archipelagos of secessionary enclaves', knitted together by networked technologies. (Graham and Marvin, 2022: 171)

Grounding their analysis in international comparisons, *Splintering Urbanism* missed many subtleties of difference *within* populations, remaining blind to how these shaped infrastructure provision and use. Invoking cases from India, Graham and Marvin failed to adequately account for 'long historical legacies' of internal segregation by race, caste, and class. (Ranganathan, 2022: 136) Responding to this specific lacuna, geographer Malini Ranganathan introduces the 'caste-splintered city', describing how 'agrarian feudal relations' have been reified and re-articulated in urban India. (Ranganathan, 2022: 138) This idiomatic spatial splintering relegates Dalit and subalternised communities to 'politically and legally manipulable' land on the city's margins. (ibid: 139-140) The resulting segregation is fractal and relational, reproduced in large urban metropolitan districts, but also at the neighbourhood scale. (ibid: 139)

Such spatial divisions are reinforced, too, by the Indian city's bimodal service provision, embedded in the aftermath of Partition's displacements, as subsequent

governments attempted to reconcile the 'demands of the titleless urban poor [too numerous to be ignored] … with the rights of legally titled urban citizens.' (Gopakumar, 2020: 71) This system shaped parallel infrastructure configurations with little apparent overlap; comprising islands of modern, standardised infrastructure connectivity, used by law-abiding, middle-class citizens, and 'mass service mechanisms', secured by the popular legitimacy and spatialised vote banks of vulnerable slum-dwellers. (ibid: 71-72)

Although "caste" is a feudal, agrarian institution, the city is not a solvent for its hierarchies of birth. In her 2006 book, *Ordinary Cities*, urban geographer Jennifer Robinson reflects on a cluster of mid-twentieth-century anthropological work on the Zambian Copperbelt, and its mining boom towns, under British colonial rule. In these fast-urbanising spaces, an influx of migrants from a 'wide range of cultural backgrounds … fostered a sociability that reconfigured 'traditional' practices of association in the context of the city.' (Robinson, 2006: 47) Robinson cites anthropologist J. Clyde Mitchell, whose work describes a re-articulation of local traditions in the city. (Mitchell, 1956) Urban newcomers were not assimilated into the existing prestige-based social system; instead,

> their own ethnic distinctiveness which they took for granted in the rural areas is immediately thrown into relief by the multiplicity of tribes with whom they are cast into association. Its importance to them is thus exaggerated and it becomes the basis on which they interact with all strangers. (Mitchell, 1956: 29)

Creating space for new affinities and forms of association, tribalism and urban life 'shaped and reinvigorated and, in some very practical economic as personal ways, depended on [each] other.' (Robinson, 2006: 48-49) Rather than some atavistic hangover of provincial, local cultures, tribalism was simply a 'category of interaction within a wider system.' (Mitchell, 1956: 30) Similarly, "caste" in the Indian city is neither remnant nor rural lifeway, but a productive, dynamic—often violent—set of relations re-articulated and embedded across the varied settings of urban life.

Within the caste-splintered city, individual Dalits and their communities are dehumanised and exploited, performing 'vital metabolic and circulatory labors' including waste collection, laundry, and meat and food processing. (Ranganathan, 2022: 139-140) This work includes manual scavenging, the ostensibly outlawed practice whereby subalternised labourers 'descend into a manhole or undertake door-to-door septic tank and dry latrine cleaning of human excreta with minimal or zero protective equipment' (ibid: 140). "Caste" offloads low-value, stigmatised work onto less valued bodies, whose inferior subject position is 'rendered hereditary and reified as flesh' (Shankar and

Swaroop, 2021: 70). Legitimated by perceptions of 'innate impurity and pollution' (Ranganathan, 2022: 137), such offloading exposes Dalit and subalternised labourers to a greater risk of accidental death, disease, or cancers; a depersonalised violence resting on, enforced, and nourished by caste. (Shankar and Swaroop, 2021: 72)

Taking a different approach to urban splintering, infrastructure researcher Prince Guma works to recast and rehabilitate the concept through a vocabulary of 'incompleteness.' He highlights a tendency to moralise splintered urbanism, with many quick to label infrastructures that 'do not yield to universality' as 'failed, fragmented, and deficient' (Guma, 2022: 62). At the same time, there is a common perception that infrastructure projects necessarily advance from less to more complete arrangements—through processes of stabilisation, maturation, and closure. (ibid: 60) Questioning these perceptions, Guma instead argues 'incompleteness' can help to understand and appreciate the variety of 'diverse, divergent, and disaggregated' infrastructure configurations. (ibid: 65) Opposing 'normative descriptions of wholeness and completeness', he instead approaches infrastructure as a 'tentative verb'; neither fixed nor neutral, but a 'constant and incessant work in progress' (ibid: 60).

Responding to a soft determinism latent in the splintering urbanism thesis (cf. Coutard and Guy, 2007), Guma emphasises the role of place, and the labour required to produce and maintain a system's different elements. (Guma, 2022: 60) As in my own discussion of appropriate infrastructure, this requires a greater appreciation of how a given system's 'demands and designs can vary' across time and space, affected by shifts in technology and everyday life. (ibid: 59) In this, infrastructure development is rarely a passive victim of, or surface for, the effects of a neoliberal, splintered urbanism. (ibid.) Instead, projects are influenced by any number of local practices, remaining open to 'continuous reoccupation' (ibid: 63). With maintenance involving struggles over patching, reconfiguration, and reassembly, incomplete infrastructures are subject to an 'incremental and continual redefinition.' (ibid.) These and other factors contribute to infrastructures' obduracy and unruliness, manifestations of a sociomaterial agency diverging from their designers or planners' original intents.

10.4.b. Infrastructural stigma and urban vulnerability

Taking a 2022 special issue of *Urban Studies* as my departure point, a second conversation addresses infrastructural exclusion, vulnerability, and urban stigma.

(Baumann and Yacobi, 2022) Addressing the urban built environment not just as a surface with signs to be decoded, but an agent that can, itself, 'produce stigma' (Baumann and Yacobi, 2022: 480), contributors focused on how the material apparatuses and sensory impacts of urban space can facilitate and justify subjects' marginalisation. Consider, for example, the aesthetic registers of the 'world-class' city. Stigmatised subjects might be prevented from accessing such 'world-class' urban spaces, through practices, structures, and institutions of differentiation and exclusion.

Alongside deliberate barriers to access, stigma also follows the 'material aspects' of splintering and 'infrastructural neglect', which operate on the would-be consumer's body, creating new vulnerabilities, dependencies, and emotional effects. (Baumann and Yacobi, 2022: 476) Stigma can also be an effect of disconnect, tracking certain sub-groups' inability to access services and fully participate in city life. (ibid: 485, 477) Disconnection can mark individual subjects as 'external to the community of rightsholders … excluding those not deemed full urban citizens.' (ibid: 478) Consider hygiene. The stigma of absent or inadequate sanitation infrastructure can construct those excluded as backwards or uncivilised; an assigned identity justifying their further exclusion as subjects 'outside modernity and the normal political order' (ibid).

Looking at how urban citizens enact their subject position as 'claimants, consumers and complainers' (Lemanski, 2022: 667), urban geographer Charlotte Lemanski describes how different versions of citizenship enacted by urban dwellers and state actors mediate access to infrastructure and urban space. (ibid: 665) As Lemanski notes, the stigmatisation of particular groups and places often happens strategically, with actors appealing to citizenship to legitimate the restriction of access to infrastructure services, disciplining 'inappropriate' or 'uncivic' consumers, behaviours, and uses. (ibid: 666, 668) Differentiated citizenship was also central to colonial rule, plotting backward, inferior local subjects 'onto spatialised landscapes of uneven access to urban infrastructure.' (ibid: 669) Rather than the often tacit technopolitics of scripted artifacts (cf. Winner, 1980; Akrich, 1993), this was a conscious politicisation of infrastructure, as a terrain or vehicle for the exercise of power.

Contributing to this conversation, anthropologist Rebekah Plueckhahn and development planner Adriana Allen provide empirical examples of urban and infrastructural stigma in Ulaanbaatar, Mongolia (Plueckahahn, 2022) and Lima, Peru. (Allen, 2022) In Ulaanbaatar, stigma follows the links between heat generation and acute

air pollution; with subjects suffering a diffuse 'negative public perception' based on their association with practices of coal-burning motivated by infrastructural lack. (Plueckhahn, 2022: 610) Writing about Lima's hilltop periphery, Allen examines how the city's new arrivals engage in auto-construction to navigate and, in some cases, neutralise the stigma of infrastructural disconnect. (Allen, 2022)

Rebekah Plueckhahn describes post-socialist Ulaanbaatar as an urban setting where normative assumptions about materiality, behaviour, and practice reify the boundary between Soviet-era apartment blocks, connected to central heating and plumbing, and an expansive district of fenced *ger* plots, named for the 'collapsible felt dwelling … commonly used by Mongolian mobile pastoralists.' (Plueckhahn, 2022: 609) Although this bifurcation produces persistent stereotypes, their details elude any simple hierarchy of value; apartment dwellers are judged 'soft' and 'privileged', even as their lifestyles are subjects of aspiration and desire—while those growing up in the *ger* districts are stereotyped as 'countryside people', uncouth and uncultured, but also tough and resilient. (Plueckhahn, 2022: 616) Only loosely attached to such stereotypes, stigma in Ulaanbaatar is primarily environmental, with negative perceptions and judgements determined by residents' proximity to certain spaces, practices, privations, and infrastructural effects. Stigma is not attached to particular districts or dwelling types, but instead turns on subjects' access to heat, and activities, such as the use of coal-burning stoves, that contribute to a collectively experienced air pollution crisis. (ibid: 608)

In her research on stigma and city-making in Lima, Peru, Adriana Allen introduces 'stigma traps', the path dependencies and exclusionary mechanisms that limit people's personal trajectories. Often subtle, these exclusions operate through a network of social, political, and material relations, encompassing everything from 'state-led laws and policies through infrastructural entitlements that reinforce discrimination, to widely endorsed stereotypes and prejudices' (Allen, 2022: 505). Those trapped are deprived of the opportunity to be part of a collective experience, as urban citizens, and left vulnerable to negative outcomes across interlocking domains, 'from social relations to tenure security, access to services and infrastructure and psychological and physical wellbeing.' (ibid: 493)

Asking where, when, and under what conditions people are able to escape these stigma traps, Allen shows how some residents of Lima's informal settlements have successfully asserted 'their right to the city as a co-created space.' (Allen, 2022: 492) She identifies long term, incremental, and often collective strategies of auto-construction and

everyday city making, which enable otherwise stigmatised city-makers to 'become fluent in claiming and realising their right to the city' (ibid: 494)—effectively recasting *themselves* as citizens with political agency. But even when successful, these and other escape strategies depend on the victim's capacity to 'draw on collective organisation and action', using their existing skills, resources, and connections. (ibid: 504) Thinking beyond Lima, Allen argues that de-stigmatisation strategies must address the frames ordinary citizens use to 'make sense of their experiences and … negotiate material and symbolic boundaries' of inclusion and exclusion. (ibid: 506) For participants and their supporters, de-stigmatisation requires sustained, continual calculations of the 'space for change' across settings and circumstances, something influenced by 'institutions, intermediary groups, cultural repertoires and contexts.' (ibid.)

10.4.c. Appropriate infrastructure in the caste-splintered city

Taken together, these two conversations show how considerations of infrastructural stigma, urban vulnerability, and service access in urban India must contend with the lived realities of race and caste, both as a splintering force and a 'brutal hierarchy' of dominance and exploitation. (Natrajan, 2022: 308-309) Caste, in particular, is the 'emblematic institutionalized form of violence' within Indian Hinduism (ibid.), an engine of the regional, place-based hierarchies shaping 'everyday life and death in India.' (Cháirez-Garza et al., 2022: 195) Casteist discrimination is the sole producer of "caste", a 'differentiating and provincial force', segmenting the Hindu population into 'provincial involuted "worlds within worlds"' (Natrajan, 2022: 308).

Although considerations of the viscosity of whiteness and India's 'pigmentocracy' (Dhillon, 2015) sensitised my study to race as an axis of produced difference, differentiation by caste was a gap or lacuna in my analysis; a consequence, in part, of the elision of "caste" in the official, sanctioned representations of my informants, members of the city's urban middle classes. At the same time, my preoccupation with the modern infrastructural ideal (Graham and Marvin, 2001) as a normative end-goal for the 'islands' of standardised connectivity on one side of India's bimodal system of urban service provision. (Gopakumar, 2020) This focus undoubtedly excluded the heterogeneous configurations used by those relegated to the urban peripheries (cf. Lawhon et al., 2017), while concealing the labour required to maintain and co-produce a continuity of service—work often undertaken by subalternised, low-caste bodies.

Within India's current Hindutva conjuncture, Dalits and Muslims threaten the integrity of the imagined Hindu nation; Dalits as stigmatised, oppressed victims of a Hindu social hierarchy; Muslims as active participants in India's history, their 'labour and creativity' evident in the constitution of India as an independent nation. (Natrajan, 2022: 305) In response, the Indian state and governing party have tried to construct and fix cultural perceptions of 'external' Muslim and 'internal' Dalit Others (ibid: 299-300); assigning these populations new social identities to consolidate a 'monolithic and hegemonic Hindu national identity.' (Cháirez-Garza et al., 2022: 206) This is less about nation-*building* than enacting or performing an 'internal frontier' where those deemed 'enemies of the nation' are 'perpetually produced and acted upon.' (Natrajan, 2022: 313) Through practices and apparatuses of differential racialisation, Muslims are constructed as '"unmixably" different', a disposable, racialised out-group, while Dalits are ethnicised, positioned as 'benign "difference"' to be disciplined and domesticated. (ibid: 306)

These and other processes have clear implications for the affected individuals and populations. Embedded in unequal labour regimes, notions of purity and untouchability continue to mediate access to water, sanitation, and resources, and subalternised Indians' claims to the city—which, though rarely openly acknowledged as such, end up differentiated by "caste." (Ranganathan, 2022: 136-137) For Dalit sanitation workers, 'fetching water or buying food become hurdles to cross', such that 'touching a tap or entering a shop' may be met with violence. (Shankar and Swaroop, 2021: 70) Simultaneously, the abjection of Muslims as 'non-Indian' restricts their ability to claim urban citizenship, hold property, and access networked infrastructural services.

While sanctioned Hindutva discourses domesticate "caste" difference, eliding its lived realities, the symbolic and material effects of stigma are clearly visible in Ahmedabad's Muslim 'sub-city' of Juhapura. (cf. Thomas, 2017; Laliwala et al., 2021; Bobbio, 2022) Tomasso Bobbio describes Juhapura as a 'paradigmatic case' of the various interlocking forces that have come together to produce 'extreme discrimination', with urban internal boundaries reinscribed by the 2002 anti-Muslim pogrom further stigmatising and delegitimising its inhabitants as urban citizens. (Bobbio, 2022: 171) Foregrounding the 'Muslimness' of Juhapura's infrastructure configurations over the whiteness and 'world-class' aspirations of the modern infrastructural ideal, such research might successfully extend this study's frames of mutability, mobility, and worlding to examine how this urban territory has come to operate as a 'stigma trap'—fixing and restricting the choices of its multiply marginalised inhabitants. (cf. Allen, 2022) Such work

might focus, for example, on service provision, auto-construction practices, and the mutability of the built environment, looking at obstacles to access and sociotechnical change in a setting that the government has 'ignored as well as erased from its administrative gaze.' (Thomas, 2017: 712)

A second line of additional research could develop Allen's discussion of de-stigmatisation strategies, looking at opportunities to resist or unmake urban and infrastructural "caste" stigma in an Indian context. Those researching urban livelihoods often rely on biographical interviews and life histories, adopting a descriptive and methodological individualism that, however politically engaged, is often blind to political mobilisation, practices of community organising, and collective action. (Lemanski, 2022: 668) The efficacy—or not—of such practices and strategies show how stigma is collectively targeted, even as its impacts isolate its suffers from connectivity and community support. (ibid: 669)

Such work might find inspiration in the emerging interdisciplinary field of Critical Caste Studies, which commits, first, to uncovering the mechanisms and apparatuses of caste-power, and, second, 'unravelling ... discursive and non-discursive counter-caste practices' (Ayyathurai, 2021). Scrutinising such mechanisms and practices as they appear across the varied settings of the contemporary Indian city, work from infrastructure studies and practical ontology might help researchers compensate for the blind spots of individualising methodologies. Looking beyond biographies and interviews, such work might take a more explicitly participatory or performative approach, combining visual and *flânerie*-inspired research practices to depict the slippery, often hidden ways in which infrastructure and the built environment mediate, reproduce, and embed "caste" in the city. Recent work on practical ontology, in particular, could help unpick naturalised caste relations. Providing a conceptual framework to name and contest caste's apparently obdurate 'worlds within worlds' (Natrajan, 2022: 308), such work might help fortify practitioners' own deprovincialising, counter-caste alternatives; proposing open-ended, experimental worldings that could capitalise on the incompleteness of the 'splintered' city. (cf. Guma, 2022)

10.5. Techno-politics and urban practice

Having identified and addressed some relevant academic conversations on caste, infrastructure, and urban vulnerability, in this section, I attempt to fulfil sociotechnical *flânerie*'s promise of producing texts of some use to urban communities of proximity and practice. As urbanist Gautam Bhan describes:

> Activists in social movements, researchers in think tanks, engineers in utilities and other companies, citizens trying to survive everyday life, residents building their own housing, or anyone trying to figure out where to get water, a job, an escape, or an opportunity: All claim the difficulty of finding articulations of knowledge that help address their particular forms of practice. (Bhan, 2019: 639)

Linking this study with an emerging sub-field of urban STS, and introducing the needs and interests of two identified communities of urban practice, I show how my research and analysis can support the activities of, first, *heritage management professionals* and, second, *participatory planners and urban designers*.

Running alongside academic conversations about splintered cities and infrastructural stigma, an emerging urban STS literature appears eager to stray beyond the academy, taking a keen interest in opportunities for more progressive, equitable urban development. (cf. Farías and Blok, 2017) This work confronts critiques of ethnographic studies of science and technology as insufficiently geared to the workings and exercise of power. Relying on case studies and detailed ethnographic accounts, many STS researchers have been reluctant to cast judgement, working instead to produce faithful accounts of their subjects' practices, artifacts, and social worlds. (cf. Beaulieu et al., 2007) This stance differs greatly from work in development studies, sociotechnical transitions, or critical urban scholarship—fields explicitly oriented towards the imperatives of poverty alleviation, sustainability, and distributive justice.

Although urban STS researchers are well placed to critique 'overly optimistic and boosterish claims', and suggest 'alternative pathways … that can selectively involve new [and established] technologies' (Karvonen, 2020: 421), these critiques and proposals are most useful when they take their place *alongside* those of subjects already engaged in urban practice—particularly in the fast-growing cities of the postcolonial global south. A composite, interdisciplinary field, urban STS eschews the top-down, managerial orientation of many development and policy professionals, with no blank slate, before or upstream, for targeted interventions. To ensure relevance, its researchers must instead articulate their knowledge of 'social values and concerns' such that it can be of practical

use to those shaping 'urban processes, policies, and infrastructure' in the present tense. (Foley and Miller, 2020: 315)

In such engagements, cities are not just 'enormous artifacts' (Aibar and Bijker, 1997), but 'messy sociotechnical achievements' with discursive, material, temporal, and spatial dimensions, all 'infused with power dynamics.' (Karvonen, 2020: 418) At the same time, as Bhan notes, speaking of practice 'requires rooting oneself in an empirical specificity'—even as he conceded a degree of uncertainty as to whether the 'contemporary Indian city', itself a label for a 'set of cities within a nation-state', is the 'correct scale or form' (Bhan, 2019: 640). In this section, I address communities of practice active in my field site of Ahmedabad (heritage managers), as well as New Delhi and Mumbai (participatory planners and architects). While my first group of practitioners reflects an existing, self-conscious ecosystem, strengthened by Ahmedabad's experience of heritage practice and recent UNESCO World Heritage City designation, the second links organisations active in different settings, based on perceived similarities in how their practices engage the generic contexts and development patterns of Bhan's 'contemporary Indian city.'

Addressing specific communities of practice is one way of re-scaling STS to better address cases and phenomena present at the local level, rather than reifying national imaginaries (cf. Anderson, 1983; Marcus, 1995b) or privileging novel, mobile, and self-consciously 'global' phenomena.[242] (Foley and Miller, 2020: 316) This rooting can hold space for alternative infrastructural configurations and new forms of urban techno-politics. (ibid.) The empirical specificity of Indian heritage professionals and participatory planners reveals a more open-ended, experimental mode of urban practice than, perhaps, that suggested by its more narrow, 'professional, formal, or institutional modes' (Bhan, 2019: 569)—providing a model for those seeking to shrink or patch the disjunctures and divisions of the caste-splintered city, as discussed above. (Ranganathan, 2022; cf. Natrajan, 2022, Ayyathurai, 2021)

10.5.a. Heritage management and conservation

As the first of two identified communities of practice, I point to Ahmedabad's heritage management and conservation professionals, a group encompassing different

[242] Though see Chapter 5, for a discussion of methods inspired by Anders Blok's work on situated globalities (Blok, 2010); pp. 63–64.

practitioners and organisations, who have become 'increasingly influential' as the city implements the conditions of its 2017 UNESCO World Heritage designation. (Jankiraman, 2021: 244) Alongside their more skilled, specialist activities, these practitioners identify heritage stakeholders; implement publicity and awareness campaigns; facilitate community participation and the use of local knowledge and resources; engage with government and state actors; and support travel and tourism. (Nayak, 2017)

In additional to prevailing local factors, Ahmedabad's heritage managers have benefited from the India-wide expansion of a 'cadre' of heritage and conservation advocates against the backdrop of 'rapidly changing urban and professional context.' (Krishna and Chalana, 2021: 280) Within Ahmedabad, these practitioners 'wielded tremendous authority' in preparing the city's UNESCO bid, and their influence has only grown, through 'advisory roles and consultations' providing expertise to cities and actors far from Gujarat. (Janakiraman, 2022: 244) Some have links to the AMC Heritage Cell, a specialist unit supporting the conservation of heritage structures through strategic public-private partnerships and international collaborations. (Nayak, 2017: 218-220) Others are associates or graduates of Ahmedabad University's Centre for Heritage Management, which provides training and regularly consults with government agencies and NGOs. The community also includes individual developers and entrepreneurs, attracted by HUDCO-subsidised loans for the restoration of heritage houses (ibid: 216-218), and convening organisations such as the City Heritage Centre, which offers support with conservation and craft skills, legal and financial resources, and economic sustainability plans.[243]

Counterintuitively, Ahmedabad's 2017 World Heritage nomination asserted a 'multicultural counter-narrative to Hindu nationalism' (Janakiraman, 2022: 237). By crafting a narrative that could appeal to an international audience of would-be tourists and investors, heritage experts were able to assert a certain degree of autonomy from a normally hostile Hindu nationalist state. But while the World Heritage process created local opportunities to resist dominant national discourses—by, for example, centring the value of multiculturalism, religious coexistence, or Gandhi's presence in the city—the degree of latitude afforded fluctuated, and alternative narratives have proved vulnerable to co-option by well-resourced investors, entrepreneurs, politicians, and the state. (ibid: 245)

[243] From CHC website, <http://www.cityhc.org/1/about-us>

While preparing the UNESCO dossier, government and heritage professionals paid little attention to the 'needs of inhabitants of this heritage' (Janakiraman, 2022: 245), making few efforts to engage local residents and communities. Ahmedabad is also a setting where many of the relevant sites remain in use. Jama Masjid and Sidi Sayyed Mosque, for example, are active places of worship, even as World Heritage classification now excludes their community and governing bodies from making decisions about their own heritage. (ibid.) The award has revealed 'hierarchies of stakeholdership' within Ahmedabad, privileging the voices and preferences of heritage experts, international audiences, and the state over those who inhabit or depend on, for example, these mosques, or the *pols* of the walled city for their livelihoods. (ibid.)

Some commentators note that the city's World Heritage inscription has been celebrated as much for its economic opportunities as any sustained pride or interest in the city's 'inhabited cultural patrimony.' (Janakiraman, 2021: 248) Nomination has accelerated the commercialisation of the historic walled city; a dynamic I encountered already well underway prior to the 2017, through, for example, Rajiv's investment in *haveli* restoration in the *pols*.[244] The connection with global audiences and international tourism has bolstered perceptions of heritage's symbolic and market value, while simultaneously *devaluing* the sustained presence and histories of its residents and dependents. (ibid.) At the same time, many surviving *pol* residences are now vacant or being let to migrant workers, many of whom are new to the city. (Janakiraman, 2021: 248) Often vulnerable or marginalised, these newer residents, often from elsewhere in India, lack the ability, resources, or motivation to assume the costs of maintaining degraded historic structures. (ibid.) The disconnect between simultaneous processes of commercialisation and neglect creates an opening for well-resourced, powerful actors to carve 'elitist zones catering to affluent tourists in the form of boutiques and galleries, heritage hotels and restaurants.' (Krishna and Chalana, 2021: 293) To avoid this outcome for Ahmedabad's heritage assets, fatalistic views of gentrification as an inevitable outcome of restoration need to be 'challenged with creative approaches' shielding historic neighbourhoods' residents and communities from abrupt shifts in land use, property tenure, or demographics. (ibid.)

One option might be to further foreground the city's 'living' heritage—something already cited as a point of distinction in the city's UNESCO inscription. Landscape architect

[244] See my discussion of Rajiv's restoration of a *haveli*'s *tanka*, or cistern, in Chapter 6; pp. 130–135.

Amita Sinha cites India's 'living' heritage as a key difference from European models of heritage and conservation practice, encompassing:

> heritage that is alive in memories, re-enacted in rituals and performances, and renewed in skills passed from one generation to the next, categorized as intangible heritage that is not embodied in monumental architecture, but in everyday acts and spaces regenerated over time. (Sinha, 2017: 227)

Confronted with the quotidian realities of living heritage, the ASI's 'monument-in-the-garden' preservation model is wholly insufficient; many valued heritage structures remain in active use, claimed by 'those living in the vicinity', or holding other locally significant roles and functions. (Sinha, 2017: 227) With multiple stakeholders each enacting their own worldings of the same assets, and state heritage institutions slow to solve problems or enforce rules, 'different cultural worlds' come to occupy the same physical space, producing a 'segmented and contested public landscape' (ibid: 228-229). In these cases, the relation between heritage structures and their settings is far less clear-cut than anything imagined by the ASI, with dynamic vernacular and kinetic 'living' heritage landscapes characterised by mess, diverse uses, and constant change. (ibid: 227)

Although heritage conservation remains a potentially powerful tool for urban development, a strategy seeking to preserve 'dead' monuments in splintered or gentrified 'heritage enclaves' can only deliver economic benefits by disconnecting citizens from the 'living traditions that give meaning and identity to their lives.' (Sinha, 2017: 239) To be effective, conservation models for 'living' cultural heritage must offer the possibility of 'non-scripted encounters with people and landscapes … settings of everyday life as it is lived in the city.' (ibid: 236) Success, from this perspective, is not a spectacle carefully staged and curated for public consumption, or a 'dead' object preserved in a 'museum-like setting' (Sinha, 2017: 239), but, rather, a recognition of the value of both material and intangible heritages, with practitioners making efforts to integrate the two. (Krishna and Chalana, 2021: 285). Enlisting heritage managers and conservation professionals to oppose the museumization and marginalisation of practical knowledge (Visvanathan, 2005: 86), heritage sites could be ordered to revive and apply traditional skills, technologies, and forms of craft practice, while remaining open to visitors. (Sinha, 2017: 349) Such a strategy could benefit those communities protecting and sustaining locally valued skills and forms of 'living' heritage. (Kristhna and Chalana, 2021: 285)

10.5.b. Participatory planning and urban design

A second identified community of practice links groups involved in participatory planning, architecture, and urban design. Representative organisations include Urbz, an experimental action and research group based in Mumbai's Dharavi settlement, and the Delhi-based Social Design Collaborative (SDC), a community-driven art and architecture practice. Operating in different cities, and with different distributions of skills and expertise, these groups share a belief in the value of bottom-up, participatory practices. For both, greater inclusion and community participation are a way to create 'stronger, inclusive and more equitable contexts' for planning, action research, and urban design (Shahdadpuri, 2021: 19), and identify appropriate local solutions. (Janu and Shahdadpuri, 2021: 180)

As an example of one such participatory project, the SDC's *'Kaun Hai Master? Kya Hain Plan'* (Hindi for '*Who is the Master? What is the Plan?*') is an interactive toolkit including under-represented citizens in planning discussions and debates about Delhi's future. (Shahdadpuri, 2021: 14) The toolkit's title critiques and subverts familiar technocratic planning instruments, playfully conceding:

> that there is a master above us all, who is male, and who will make plans for us which might not even come to know about, [let] alone, be able to understand and influence. (Janu and Shahdadpuri, 2021: 174)

Exploring alternatives to this master plan logic, the toolkit was produced as part of '*Main Bhi Dilli'* ('*I am Delhi too*'), a civil society campaign engaging Delhiites typically excluded from planning processes, as a first step in communicating their concerns and interests to those formulating the 2041 Delhi Master Plan. (Janu and Shahdadpuri, 2021: 173) Community meetings were held from 2019, and continued through the COVID-19 pandemic, with reduced numbers and some workshops moving online. Five toolkits were used by different organisations to run over 100 workshops in Delhi between July and August 2021, resulting in over 25,000 objections—significantly more than the 5000 lodged through the Delhi Development Authority's official online portal. (ibid: 174)

'Kaun Hai Master? Kya Hain Plan' responded to the deficiencies of a technocratic planning process with no mandates for public or stakeholder participation. (Shahdadpuri, 2021: 15) Recognising a disconnect 'between the city we live in, and the city imagined by the plan' (Janu and Shahdadpuri, 2021: 173), the SDC's designers broke down jargon-laden, English-language documents into the Hindi vernacular, reworking text-heavy, hard-to-access PDF documents into something more participatory and game-like. (Shahdadpuri,

2021: 15) Activities were piloted with informal and home-based workers, waste pickers, farmers, and women living in Delhi's peripheries. (ibid: 16) A structured rubric created a hospitable space to share issues and local narratives in open focus groups, supporting different levels of engagement. (ibid.) The toolkit used visual prompts, scaling land use maps to the size of bedsheets as a prompt and focus for discussion, and conducting polls with '*bindis* and tapes' to steer collective participation. (Janu and Shahdadpuri, 2021: 174)

Rather than simply critique urban planning as an apparatus of power, SDC's designers crafted an artifact and series of linked activities that could bolt on to formal, state-organised planning processes. These propositional tools empowered participants, while fulfilling a need to translate, expand, and ground the often abstract language of formal policy and planning; institutional urban practices normally occurring at some distance from those who ultimately bear the brunt of their effects. (Janu and Shahdadpuri, 2021: 172-173) By bridging representations of the state-imagined city and participants lived experience, the SDC's toolkit enabled a two-way traffic in concepts and terminology. Referring to self-built settlements as *bastis* rather than slums, for example, familiar 'local lexicons' helped bring participants into the process. (ibid.) These same participants later appropriated elements of planners' language and frameworks as a resource for their own self-advocacy efforts. (ibid: 176-179)

Beyond participatory planning, Urbz and the SDC's design and construction activities frequently 'spill out' beyond the kinds of professional, formal boundaries that would otherwise neatly map certain urban practices to certain kinds of practitioner. (Echanove and Srivastava, 2021; cf. Bhan, 2019: 639-640) Instead, both groups' projects have found ways to support the interests and priorities of the communities they work alongside, helping to facilitate practices of squatting, auto-construction, and adaptive repair. (cf. Bhan, 2019) Since 2019, Urbz have collaborated with Dharavi residents and local artisans to design, build, and improve many small homes and community structures. (Echanove and Srivastava, 2021) Their participatory practices contrast with public-private slum-networking or -upgrading schemes. Seeking to integrate slums into the formal city, such projects extend infrastructure services and tenure security, with the intent of giving residents greater confidence to invest in improving their own homes. (cf. Das and Takahashi, 2009; Chatterjee, 2018)

Resisting forced evictions and clearances, and rejecting lofty promises of integration with the city's serviced core, Dharavi's wealth of skills, resources, and community capital

instead support locally-situated construction practices that fall 'outside the planned regimes of urban habitats.' (Echanove and Srivastava, 2021) Many of the settlement's spaces and structures would elsewhere be deemed 'informal'—an adjective evoking that which 'lacks form … is messy, confused and irrational, and should be replaced with something neat and orderly.' (ibid.) Rejecting this label, Urbz instead refer to the resulting designs as 'homegrown', asserting the 'capacity of a settlement to develop from within.' (ibid.)

In much of Urbz's work, there is a sense of Dharavi as simultaneously ordinary and extraordinary, with its extreme size and density reflecting a 'prevalent urban condition' (Echanove and Srivastava, 2021). As they describe:

> When global capital stops speculating, when state bureaucracies fail to 'modernise' our infrastructure (or simply maintain it), when architects find themselves out of jobs, what we are left with are homegrown neighbourhoods, which reclaim growth at their scale—locally, incrementally and spontaneously. (Echanove and Srivastava, 2021)

Dhavari's residents also suffer the stigma of infrastructural disconnect, denied access to basic services on the grounds that their properties and settlements should be redeveloped, rather than upgraded or repaired. (cf. Baumann and Yacobi, 2022) For more than three decades, the Mumbai municipal authority has planned to redevelop Dharavi. (cf. Chatterji, 2015) On paper, there is a plan to turn Dharavi's low-rise, mixed-use, high-density neighbourhoods into high-rise mass housing, following a model that has failed elsewhere.[245] These plans have faced widespread public opposition, forcing the municipality to pursue a more limited, 'piecemeal implementation'—using a new metro station's promise of connectivity as a bridgehead for development. (Echanove and Srivastava, 2021)

In the meantime, Urbz have recently taken an interest in an idiomatic mixed-use building type they and their collaborators describe as 'tool-houses.' In 2016, they invited local building contractors to design the 'best possible … typical Dharavi tool-house' they could imagine. (Echanove and Srivasta, 2021) They then worked with artisans to turn the designs into physical models. Initially understood as a way to translate participants' practical knowledge and resourcefulness into a legible form, which professional architects could relate to, the resulting project, *The Design Comes as We Build*, came to evoke an dynamic urban setting where buildings are often made without plans or drawings. First

[245] 'Built in haste, with poor design and even poorer materials, these soon become dysfunctional … 'Slum-dwellers' seem to leave rehab buildings shortly after being resettled, having lost their connection to the neighbourhood, which is not just a place to live, but also a space of intense economic and social activity.' (Echanove and Srivastava, 2021)

exhibited at Urbz's Dharavi office, and then at a Mumbai museum, these model tool-houses went on to be exhibited at institutions in Rome and Lille, with three examples acquired by a museum in Hong Kong. (ibid.) Capitalising on these successes, the team recently initiated a new phase of the project, *Homegrown Street*, which hopes to fund the 'upgrading of an entire street by selling models of each house.' (ibid.)

As a further example of this kind of urban practice, the Social Design Collaborative's founder, architect Swati Janu, has attracted international attention for *ModSkool*, a design for a low-cost, modular school that can be 'built in a few days and … dismantled within a few hours.'[246] Erected on the banks of the Yamuna river, a contested space in the heart of New Delhi, the school serves a farming community of 1000 families, living and working without formal land tenure. (Bhan, 2022) In 2017, a first version ('phase') of the school was built in under three weeks, with the support of students, residents, and volunteers. When this structure had to be taken apart following land ownership disputes, a similar structure was quickly recreated further south of the river.

ModSkool demonstrates the challenges of practising architectural design in a splintered setting where resident farmers, workers, and their children are regularly 'threatened with eviction', or stigmatised as 'matter out of place' (Bhan, 2022). As Gautam Bhan describes, this project showed the 'potential of modular, temporary, rooted design' in otherwise resistant or intractable settings, as a way of buying the community time. (ibid.) Arguing for the imperative to build, 'without permissions, without certainty, without any formal recognition of the structure', Janu recognises this is how those practising auto-construction elsewhere in Delhi 'have always built' and, thus, 'how architects must also engage.' (Bhan, 2022)

10.5.c. Intermediaries and urban sociotechnical change

In this section, I examined the activities and priorities of heritage professionals and participatory planners, with the intent of finding articulations of knowledge from my own study that could be of use in their own practice. Both groups are examples of intermediary actors, using their practical knowledge to navigate the 'material-practical contradictions' of urban change (Björkman, 2022: 4); a techno-political process characterised by confrontations between intersecting ontologies and systems of meaning. (Mitchell, 2021: 415) To mediate and resolve such contradictions, these groups bridge past and present,

[246] From website, <https://www.socialdesigncollab.org/modskool/ModSkool---Phase-2>

state and citizen, production and consumption, grappling with multiple enactments of modernity, heritage, and inclusion—as articulated across different urban spaces, and with diverse effects on residents, consumers, and wider communities.

Though both groups engage with professional and educational institutions, and are able to act within the known disciplines that delineate and anchor their respective communities, individual practitioners have been able to transcend the limits of 'normative conceptual categories and institutionally empowered frames' (Björkman, 2022: 14). They have also benefited from a pluralisation of relevant actors and contexts beyond those recognised by more institutional, professionalised forms of heritage, planning, and architectural practice. Embracing a more 'expansive sense of different *ways of moving*', they have deployed varied tools, methods, and strategies to support their urban practice, as circumstances permit. (Bhan, 2019: 640) These factors have allowed them to respond, creatively and expansively, and often in propositional terms, to the transformations and flux of their operational contexts; the varied urban spaces and settings of India's 'kinetic' cities. (Mehrotra, 2007)

For Urbz and the Social Design Collaborative, urban practice cannot be limited to design and building—arriving when a structure needs to be built, then leaving when the job is complete. (Bhan, 2022) Instead, more sustained, longer-term engagements require an eclectic range of tools and methods, a fresh vocabulary, and incremental practices of 'mapping, advocacy, organising, drawing, translating, struggling, communing.' (ibid.) These approaches can support enactments of architecture and design as a 'practice of politics; of place rather than site; of collectives, cities, communities and people rather than projects.' (ibid.)

Alongside participatory planners, heritage practitioners are also, I suggest, favourably placed to help manage urban change; as growth, confrontations with difference, the articulation of new goals and aspirations, and—as in the case of the UNESCO World Heritage inscription—the 'appearance of new poles of power or prestige.' (Mitchell, 2021: 415) So though it is common for the heritage sector to 'discuss change in terms of the loss of something rather than possibilities' (Mehrotra, 2007: 347), I instead follow Debashish Nayak, director of Ahmedabad's Centre of Heritage Management, in arguing that heritage practitioners need not—and *should* not—simply be agents of preservation, opposed to all and any change. Already active participants in debates over value and 'cultural significance' (Mehrotra, 2007: 346), they can help mediate the

transition from past to present, minimising damage while maximising the benefits for residents and other relevant actors. (Nayak, 2017: 212)

This might, as suggested above, involve exploring expressions of 'living' heritage or possibilities for adaptive reuse—but this would require a more expansive approach to heritage than that currently embraced by the sector. In Ahmedabad, for example, early interaction with French and European heritage experts led the city's practitioners to adopt 'western standards' over indigenous practices; with 'local knowledge sharing and scholarships to study in France' exposing them to 'Eurocentric principles of authenticity' and Western heritage ideals. (Janakiraman, 2022: 242) Thinking propositionally, an alternative, more 'appropriate' conservation strategy could promote the city's historic buildings and monuments as community assets, identifying interventions that could support their role and use as active repositories for local tradition, culture, and identity. (Nayak, 2017: 211)

10.6. Appropriate infrastructure in Modi's India—and elsewhere

In this final section, I want to bring my outline of appropriate infrastructure into dialogue with more recent developments in India and elsewhere. During the planning, fieldwork, and writing up of this study, India has shifted from a liberal democracy to illiberal ethnic democracy (Smooha, 2002), and more recently, something closer to 'competitive authoritarianism'.[247] (Levitsky and Way, 2010; 2020) As Amit Rai describes:

> Narendra Modi's socially conservative government embraces a vision of neoliberal globalization that projects a strong, business-friendly India outward, while managing increasing internal caste, class, gender, and sexual antagonisms through an unwieldy combination of censorship, subnationalism, financial/fiscal enclosure, patronage, populism, intimidation, and violence. (Rai, 2019: 137)

In practical terms, the Hindu nationalist BJP's 2014 and 2019 election victories have translated into political dominance[248], growing ideological hegemony, and the hoarding of top-down, institutional power at the Centre. (Jaffrelot and Verniers, 2020) Mounting an assault on democratic norms and practices, the Modi regime has weakened many of India's institutions, while strengthening those supporting its drive for top-down,

[247] A concept used to combat a democratising bias in accounts of the aftermath of the Cold War, which often treated hybrid regimes as flawed or incomplete democracies 'in transition', benchmarked against the political and institutional systems of the US and Western Europe. (cf. Levisky and Way, 2010: 3–4, 26–27)
[248] Nationally, if not yet at the state level.

authoritarian power. (Manor, 2021) Stacking the deck in favour of incumbents, competitive authoritarianism produces a 'hybrid system that retains the outward appearance of democracy with little actual substance' (Manor, 2021). This shift was recently demonstrated by the NDA government's top-down, centralised response to the first wave of the COVID-19 pandemic in 2020, with harsh restrictions on movement violently enforced by the authorities. (Mukherji, 2020; Pickard et al., 2020)

This Indian model of competitive authoritarianism has been 'poorly institutionalised and shallowly rooted' beyond the charismatic authority figure of Narendra Modi himself, with his monopolisation of power preventing the emergence of any clear or credible successors. (Manor, 2021) But while the BJP and NDA government's durability and long-term prospects are not assured (cf. Siegfeld, 2020: 149-151), the speed of the transition from liberal democracy to competitive authoritarianism (cf. Freedom House, 2021) poses questions about the role of infrastructure and urban development in, and under, populist majoritarianism. (cf. Chatterji et al., 2019; Govindrajan et al., 2021) With this as a backdrop, questions about normative criteria of 'appropriateness' and the possibilities of appropriate infrastructure may appear toothless, offering little purchase on prevailing structural constraints faced by actors on the ground.

Since the 2014 general election, Modi and India's NDA government have moved to cement the political and cultural hegemony of their pro-market Hindutva, eroding political rights, civil liberties, and institutional norms. With limited, fragmented parliamentary opposition to the Centre's agenda, the most plausible sources of resistance have come from outside parliament, through emergent social movements, protest, and occupation. India's recent experience of the COVID-19 pandemic has been punctuated by protest, with fierce, sustained resistance to the planned Citizenship Amendment Act and National Register of Citizens in 2019-2020, initially centred on Delhi, was quashed under the cover of a harsh pandemic lockdown.

Figure 12. Reverse osmosis water purifier set up for use by protesting farmers at the Tikri border by UK-based Sikh humanitarian non-profit Khalsa Aid, 30 January 2021 (@khalsaaid_india).

In August 2020, farmers from the north Indian states of Punjab and Haryana occupied the Delhi border for 16 months, to protest laws that would have opened government-regulated agricultural markets to corporate actors and the private investment. In an Indian context, these activities evoke comparisons with infrastructures supporting mass-scale religious festivals, such as the Kumbh Mela, monastic and temple communities, work on disaster response and refugee camps, as well as studies of prefigurative politics, voluntary organisations, and practices of *langar*[249] and mutual aid—as seen both in the Indian farmer protests (see Figure 12), and grassroots, bottom-up responses to the COVID-19 pandemic. (cf. Pickard et al., 2020)

As a concluding point, possible future avenues of inquiry need not be limited to the urban and peri-urban landscapes of India, South Asia, or the global south. Emphasising the continuities in infrastructure and urban development trajectories in the global north and south, once-clear post-war worldings are fragmenting, losing their explanatory power in

[249] The community kitchen of a gurdwara, which serves meals to all, free of charge, irrespective of religion, caste, gender, or income; a term recently extended to other forms of service provision by the Sikh community, through 'wifi *langar*', 'oxygen *langar*', etc.

the face of common transboundary challenges such as anthropogenic climate change and pandemic viral disease. Considering the politicisation of New Delhi's £2bn Central Vista Redevelopment Project (Guha, 2020; Dhara Dharwadker, 2022); promissory accounts of freeports as engines for regional economic development in post-Brexit UK (BBC News, 2021); or current proposals for EU-Indian counterpart to China's Belt and Road Initiative (Peel et al., 2021), infrastructure and sociotechnical change remain live and contested issues at the time of writing, in April 2021. My framework of mutability, mobility, and worlding could be usefully extended to these cases, and others—with considerations of appropriate infrastructure an effective base for intercultural comparisons, a critique of Euro-American modernist ideals, and a call to prioritise users' needs over those of investors and politicians.

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Appendix 1: Sociotechnical flânerie in the postcolonial city

	Benjamin's *flâneur*	Sociotechnical *flâneur*	Sociotechnical *flâneur* in the postcolonial city
Walking	• Pedestrian mobility • Solitary, untethered, unencumbered • Part of the crowd • Pursuing 'body contact' with the city • Unhurried gait, operating outside of organised time • *Flâneur*'s mobile body unmarked, naturalised, elided in texts	• Multimodal mobilities • Solitary, untethered, unencumbered, but part of a community of research practice • Part of the crowd, audience, would-be user base • Pursuing opportunities to ruminate (Karvonen, 2008) on the subjects of inquiry • Unhurried gait, the sustained durations of fieldwork • Researcher's mobile body sometimes present in texts, as an instrument of research	• e.g. Auto-rickshaw mobility • By turns solitary, participating in contingent communities of proximity and practice • In but estranged from the crowd, a body out of place • Pursuing 'body contact' with the city, opportunities to ruminate (Karvonen, 2008), and patterns of difference • Multiple velocities within the sustained durations of fieldwork • Researcher's mobile body present in texts, as implicated in processes of subjectification, racialisation, gendering, class, etc.
Observation	• Dispersed attention • Disengaged voyeur • Focus on urban environments, people, commodities • Details, cues, signs • Interest in urban spectacles	• More purposive attention • Engaged observer • Focus on urban environments, people, commodities, objects, infrastructures, technologies • Details, cues, signs • Interest in urban and technological spectacles, border areas where closed organisations interface with the public (Ortner, 2010)	• Dispersed attention, reflexivity towards allocation and modes of attention • By turns disengaged voyeur, engaged observer, would-be cosmopolitan • Focus on urban environments, people, commodities, objects, infrastructures, technologies • Details, cues, signs • Interest in urban and technological spectacles, border areas where closed organisations interface with the public (Ortner, 2010)
Knowledge production	• Addressing a fragmented urban experience • Scopic authority of first-hand observations • Subjective data • Mapping and interpreting correlations • Impressionistic findings, integrated with scientific research	• Addressing *relational* dynamics of urban change • Scopic authority of first-hand observations, 'polymorphous engagement' (Gusterson, 1997) • Subjective, partial data • Mapping and interpreting correlations • 'Faithful accounts' (Zeitlyn, 2009), triangulated against secondary sources, situated through lateral comparisons, appeals to theory	• Addressing *relational* dynamics of urban change • Scopic authority of first-hand observations, 'polymorphous engagement' (Gusterson, 1997), practices of reflexivity and disclosure • Subjective, partial data • Mapping and interpreting correlations • 'Faithful accounts' (Zeitlyn, 2009), triangulated against secondary sources, situated through lateral comparisons, appeals to theory, and 'non-Western analytical resources' (Law and Lin, 2017)
Authorship of texts	• Creative production of literary accounts • Representational accounts of modern life, transformations and turbulence	• Production of reportage and 'thick description' (Geertz, 1973) • Representational accounts of infrastructure, urban transformations	• Creative production of hybrid texts, blending literary accounts, reportage, and 'thick description' (Geertz, 1973), deconstruction of colonial tropes and stereotypes • More-than-representational accounts of infrastructure, (post)colonial urban transformations and

	• Mimetic realism alongside socio-economic observations • Urban popular audiences	• Mimetic realism, analysis • Academic audiences, members of the community of research practice	turbulence • Mimetic realism, supplemented with use of the *irrealis* mood (Vannini, 2015a), analysis • Academic audiences, interlocutors, members of those contingent communities of proximity and practice