

The London School of Economics and Political Science

Waterworks

Labour, infrastructure and the making of
urban water in Mexico City

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Declaration

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Abstract

This dissertation explores the role of human labour in managing, maintaining and repairing infrastructures on the everyday, and how these current practices relate to the interlinked histories of labour and infrastructure. Namely, it focuses on how manual workers within the Mexico City Water System (SACMEX) carry out their daily tasks, and how these are crucial for the networked grid, the public utility and state power over hydraulic resources to endure. I highlight how an array of labour practices entail diverse forms of improvisation, creativity and adaptation, learned through collective, long-standing engagements with infrastructures. I show that these labour practices are necessary for infrastructure to adapt to socio-material changes, for SACMEX as an institution to retain its grasp on these infrastructures and on the water that flows through them, and for state power to be maintained amidst deepening austerity and ongoing material decay. Drawing upon literatures that analyse these entanglements from different perspectives, including critical political ecology, object-oriented approaches and Southern urbanism, I make a distinct contribution by theorising the role that informal, improvisational and adaptive human labour has in formal infrastructural systems. This has far reaching consequences not only for how we understand the endurance of these networks, including their material and institutional workings, but also for how we conceptualise the specificity of human work amidst theorisations of a post-human world. Methodologically, I draw upon participant observation carried out with workers at SACMEX over the course of one year, developing concepts and explanations based both on my analyses after the field and on the ways in which workers themselves described and defined their own labour. Whilst the analysis of these waterworks is firmly rooted on the geographical and historical particularities of Mexico City, it can provide descriptions, concepts, and methodological and analytical strategies useful to explore and theorise how labour and infrastructure shape each other and the cities we inhabit.

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1. INTRODUCTION

“¿De dónde y cómo traer agua hasta una ciudad trepada sobre el altiplano, sin ríos caudalosos que la alimenten? Agotados los mantos acuíferos y exprimidos los manantiales más próximos se hará indispensable ir cada vez más lejos por el agua; entubarla a lo largo de kilómetros y kilómetros, almacenarla y bombearla luego con mayúsculos esfuerzos y gastos de energía a un costo estratosférico. En diez o en veinte años, antes de que termine el siglo —decía el Joven Juárez— un vaso de agua será tanpreciado y tan costoso como un vaso de leche.”

“From where and how to bring water to a city perched on a plateau, without large rivers that feed it? Once the aquifers are exhausted, and closest springs squeezed out, it will become indispensable to go further every time to get water; pipe it across kilometres and kilometres, store it and then pump it with enormous efforts and energy usage at a stratospheric cost. In ten or twenty years, before the century is over – Young Juárez said – a glass of water will be as precious and expensive as a glass of milk.”

Vicente Leñero – La gota de agua (1983)

Water is central to literary, scholarly, and quotidian histories and stories of Mexico City. The presence, absence, or excess of this liquid is a shared concern amongst urban dwellers and has been so for the past centuries. This importance is in many ways unsurprising. Water provision and sanitation are crucial in all urban spaces, and water is indispensable for life as such. However, in Mexico City accounts often take a mythical dimension. Water is at the root of the city’s relationship to space, history, and the future. Narratives often speak of a paradise lost to urbanisation, capitalism, and modernity (Legorreta, 2006); a former city on a lake (Vitz, 2018) that is now only present in memory and few scattered water bodies in the City and its hinterlands. Narratives also deal with the everyday struggles of accessing water in a city where its scarcity is mark and make of unequal ways of living; they imply not only differentiated access to water and sanitation but also unequal relations, perceptions and practices concerning hygiene, odour or leisure (Leñero, 1983; Schwarz, 2017). Water presence, moreover, is entangled with threat, nostalgia and hope. Catastrophes past are

reminders of disasters yet to come, and present pollution, traffic, and urban sprawl are constant reminders of utopian futures that never came to be. Mexico City, where once five interconnected lakes created the 'most transparent region' (Fuentes, 2008), is now depicted as an urban behemoth where chaos and the uncanny come to be.

Amidst the many travails related to water in Mexico City, the task of provision stands apart, alongside the problem of drainage (Perló Cohen, 1999). The city's relationship to water has been described as a paradox, in which insufficient supply coexists with recurrent flooding and the undying memory of it. To make the city endure, urban elites, multiple governments – local, national, and imperial – and innumerable workers have built infrastructures that seek to control, manage, and produce water as either resource or waste (Perló Cohen, 1989; Candiani, 2014). Massive drains, sprawling supply systems, and pumps that have extracted so much water that the ground is subsiding, are all material testimonies of these ongoing processes. These infrastructures have been built over the course of several centuries, and their materiality forms a palimpsest through which the intertwined making of city, nature, power, and society can be seen. New drainage projects expand the functions previous ones carried out; dams, pumps, aqueducts, and pipes bring water to city from neighbouring basins: both link spaces far from Mexico City to its ever-growing needs.

These infrastructures serve more than technical goals. They are also entangled with diverse political, social, ecological, and economic projects, and are a fundamental part of their material production. The *Gran Canal del Desagüe*, a drainage infrastructure built between 1607 and 1910, allowed the desiccation of the basin, and fostered the expansion of the city. Its construction became entangled not only with the production of urban space but was also instrumental in advancing and producing diverse class and group formations in colonial Mexico (Candiani, 2014). At the same time, it produced a new set of political ecological relations, and gave way to larger projects that have incessantly sought to control water flow

inwards, within, and outwards the Mexico Valley (Perló Cohen, 1989; Perló Cohen & González Reynoso, 2005; González Reynoso, 2016). The Xochimilco Supply System, built between 1904 and 1911, had as its goal the introduction of modern water for Mexico City's wealthy inhabitants. In doing so, it produced an urban space riddled with inequality, whilst simultaneously subordinating the Xochimilco region, then outside of the city, to its wants and needs (Banister & Widdifield, 2014; 2016). These infrastructures, and indeed many others, have been central in producing urban space, its inequalities, and its political ecology across time and space.

In their everyday operation, water supply infrastructures often do not conform to their projected functions. Leakages, obstructions, illegal connections, and unexpected breakdowns interrupt the ideals of seamless flow and total control over nature. Official sources affirm that around 42% of the total water supply of Mexico City is lost to leaks (SACMEX, 2018). Workers at SACMEX (*Sistema de Aguas de la Ciudad de México*), the public utility that manages water supply and sanitation in the city – the waterworks that give this dissertation its title – often talk about the many illegal connections that proliferate with the acquiescence of bureaucrats, politicians, and engineers. As the grid ages, rusts, and decays, the tasks of maintenance and repair become indispensable to ensure that households, industries, offices, public and leisure spaces are supplied. Simultaneously, growing concerns about water availability intensify, as sources are depleted, climate patterns change, and consumption continues to increase. Modern ideals of equal, permanent, and abundant supply are challenged, and their future viability is cast into doubt. Future imaginaries of scarcity and citywide breakdown proliferate, highlighting the fragility of current patterns and practices of water consumption and supply in Mexico City.

This dissertation explores the role of human labour in managing, maintaining and repairing hydraulic infrastructures on the everyday, and how these current practices are rooted in and

can be a standpoint to explore infrastructures' material history and the role of labour therein. I analyse this through an ethnography of the Lerma Water Supply System (henceforth the Lerma System, or, simply, the Lerma). Built between 1942 and 1951, the Lerma was part of a widespread programme of state-led capitalist modernisation and urbanisation (Albores Zárate, 1995; Boehm de Lameiras & Sandoval Manzo, 1999; López-Portillo Tostado, 1995; Medina, 1978; Medin, 1990), and still supplies the city with 12% of its daily water (SACMEX, 2018). It sought to provide a growing city with plentiful water, and in doing so it became part of the making not only of city and nature, but also of the Mexican post-revolutionary state (Aboites Aguilar, 1998; Cirelli, 1997). Crucially, the numerous relations between nature, state power, and the city that were brought together through the Lerma infrastructures are not confined to the past. My main argument is that they endure and are adapted through contemporary labour practices and processes of management, operation, maintenance, and repair. I substantiate this claim through an analysis of the adaptive and creative labour practices (Graham & Thrift, 2007) that workers carry out today as they fix and maintain these infrastructures, framing them in the broader history of the project as told by workers, documented in archives, and discussed in previous research.

What is maintained and adapted through infrastructural labour is not only the supply of urban water but also the promises that were made through it (see Anand, Gupta & Appel, 2018). The notion of a just, modern city implied the expected universal expansion of piped water supply (Vitz, 2018), and indeed this goal has been central to state policy since, at least from a legal point of view – even if it remains unfulfilled (Castro, 2004). However, this inconclusion does not equate to its complete demise or disappearance. Regular water supply is still expected, even amidst prolonged austerity conditions, decreasing budgets, and decaying infrastructural provision. Certainly, constant access to good quality water is unequally distributed in Mexico City (Schwarz, 2017), and, as I will show in this dissertation,

repair and maintenance practices often reproduce these inequalities. However, through the aforementioned creative and adaptive practices, workers do maintain water flowing and, with it, make the promises of modernity, social justice, and development that were made through the Lerma withstand, even if unequally distributed, porous, patchy, and under constant breakdown and threat. This suggests that urban modernity is a precarious achievement, and that its making and maintenance are in need not only of constant care and repair, but also require constant adaptation – tasks in which human labour is fundamental.

As mentioned before, I carried out a one-year ethnography of the Lerma System, focusing on the human labour that sustains it today. I focus on three groups of workers: 1) repair and maintenance crews; 2) mid-level engineers and their aides; and 3) office workers at SACMEX field offices. To better understand current practices, and how they relate to the history and materiality of the Lerma System, and SACMEX at large, I carried out archival research, mainly in the Historical Water Archive (AHA), in Mexico City. I was interested in exploring how the Lerma was projected and designed, and how it was made into an object of state control and knowledge. This ethnographic approach allows for an exploration of how the Lerma System infrastructures are produced materially; how they are brought under the gaze and management of public experts and employees; and how they are maintained and repaired by manual workers in a context of decreasing budgets and ongoing deterioration. By following these waterworks through documents, narratives, practices, and processes, I develop the argument that infrastructures, the urbanisation of water, and the projects and promises made through them are made enduring through everyday labour practices of maintenance, repair, and management. In doing so, different workers, experts, and

bureaucrats are not only reproducing historical material processes and institutions; they are also enabling their adaptation through creative, ingenious, and purposeful labour practices.¹

In what follows, I introduce how I conceptualise the relations between human labour and infrastructure, and the specific role that the former plays in producing, maintaining, repairing and adapting the latter. I then elaborate on how this conceptualisation relates to how nature, state and urbanisation have unfolded through the Lerma infrastructures, and to the ways in which human labour participates in this. Whilst interested in the everyday, I also take into consideration the promises that shaped the Lerma at the time of its design and making, as these are also at play, framing present labour as bounded by materiality and its history. Indeed, much of the historical background is provided in this introduction. The approach I develop here dialogues critically with current scholarship that explores how infrastructures, specifically hydraulic ones, are productive of diverse technical, political, economic, ecological, and historical relations and configurations in urban spaces and beyond (Gandy, 2002; 2014; Swyngedouw, 2004; 2015; Meehan, 2014; Anand, 2017).² In particular, it engages with recent analyses of the role of human labour in sustaining infrastructures and the relations they enable (Alda Vidal, Rusca & Kooy, 2018; Anand, 2011, 2015; Björkman, 2015, 2018; Baptista, 2019; Barnes, 2017).

This dissertation contributes to this scholarship by further theorising the role that informal, improvisational and adaptive human labour has in formal infrastructural systems. I show how diverse forms of work, which often exceed official ways of doing, are central in keeping infrastructures together, adapting them to ongoing change, and sustaining and adjusting how they are managed as part of a public utility. This has far reaching consequences for how

¹ The methodological approach of this dissertation will be discussed in depth on Chapter 3.

² Chapter 2 develops these theoretical arguments and dialogues thoroughly.

we understand the endurance of these networks, including their material and institutional workings. Specifically, it suggests that distinguishing between how different forms of labour relate with and shape infrastructure is a productive standpoint to interrogate how socio-material change, both expected and unexpected, is responded to and worked with on the everyday. Different forms of labour engage with infrastructures in specific ways, shaped by situated collective practices and knowledges, and bounded by the materiality of the grid and of water, soil, and other processes and objects at play. Here I focus on archival, maintenance and operation, repair and management work, and show how each one of these standpoints provides complementary insights into the role of human labour in and through infrastructures. These theorisations are relevant for how we conceptualise the specificity of human work amidst theorisations of a more-than-human world.

LABOUR AND INFRASTRUCTURE

Labour is at the heart of this dissertation. Focusing on workers' narratives, practices, and knowledges, I argue that centring human labour is crucial to understand how infrastructures are made stable, and how the hybrid relations they bring together endure. This fundamental role to human labour is not a claim against hybridity, but rather, I posit, a way to better understand how hybridity is made, maintained and adapted. This argument engages critically with contemporary scholarship on infrastructure repair and maintenance (Graham & Thrift, 2007; Anand, 2011; Denis & Pontille, 2014; Barnes, 2017; Alda-Vidal, Kooy, & Rusca, 2018; Baptista, 2019), as well as with broader accounts of hybridity, materiality, and human and more-than-human agencies (Swyngedouw, 1996; 2006; Gandy, 2005; Latour, 2005; Bennett, 2010). These works, and indeed others, have greatly contributed to our understanding of how infrastructure and labour entwine in the production of hybrid relations and spaces – as I will discuss in the following chapter. However, I posit that a conceptualisation that considers

the specificities of human labour in light of current developments on infrastructure studies, and their accounts of materiality and non-human agencies, is still missing.

This approach is the one that I seek to develop in this work. I do so by exploring how different forms of labour shape and are shaped by infrastructure and the multiple socio-material relations that both are bounded by. These forms of labour are those of maintaining and repairing, themselves constituted by other subsidiary practices such as archiving, managing, operating, improvising, and converting. I show how these two forms, and the practices related to them, entail diverse relations to hydraulic infrastructures and their material histories in Mexico City. This multiplicity works as an analytic tool to query distinct aspects of the relation between labour and infrastructures, and of the role that the latter plays in making the former endure. This certainly does not mean that these forms of labour are incommensurable. They are all instances of the practice and process of labour, which is a world-making activity that is always being developed through and with the world external to the worker (Marx & Engels, 1959, pp. 229-346). Crucially, this external world is one where matter matters (Bakker & Bridge, 2006), a fact that calls for analytical attention to the socio-materialities in which labour and infrastructure are embedded.

In turn, taking into account materiality as something that shapes and bounds human agency calls upon a careful consideration of how this lively matter came to be, and not only what it does in the present moment. This is where the historical exploration of the Lerma System, and of the promises made through them, comes into play. The infrastructures that workers operate, manage, maintain, repair and document in archives are both products of their labour and appear as subordinating them to the tasks at hand, and to the processes that they sustain (Marx, 1993). Yet, they do so not as mechanical, increasingly automated activities. Instead, creativity, improvisation, ingenuity and practical knowledge are called upon to respond to socio-material changes that transform water availability and flow, soil

composition and subsidence, and that rust and breakdown the networked grid. These changes are historical processes themselves, yet the ways in which they surface on the everyday are oftentimes unexpected and call for the improvisational and adaptive work that I analyse here.

This improvisational labour has been analysed in the context of informal infrastructure provision across cities of the Global South (Silver, 2014; Simone, 2004a; 2013). To carry out this exploration within a formal, networked grid is one of the main empirical contributions that this dissertation puts forward. The stakes of incrementality and improvisation on this type of formal infrastructure do not concern how these practices might prefigure other ways of producing and inhabiting the city, but instead shed light on how certain forms of power, inequality and difference are adapted to ongoing change through everyday interactions between human labour and infrastructures. It is there where the specificity of human work becomes more evident, and where it makes its bid for significance. It does so in ways that paradoxically exceed and challenge official ways of doing yet sustain the unequal and uneven relations and forms that the formal grid entails. This dissertation shows how the often unheralded forms of work that I analyse here are crucial for formal infrastructures, and the institutions that seek to control and govern through them, to endure and adapt, and that they do so both a set of concrete, situated practices, and as an abstract, ongoing process.

Analysing together labour as practice and process seeks to highlight its role in making the worlds we inhabit, a position informed by early Marxist approaches to this question (Marx, 1993), and by more recent work on critical political economy and ecology (Loftus, 2007; 2012). However, it is also one that takes the question of situatedness (Lawhon, Ernstson, & Silver, 2014) into account and uses it to query how labour is carried out and what it is. This implies thinking it not as a crystallisation of power or social dynamics residing elsewhere but rather as a relational practice and process that is always being made through interactions

between workers and the outside world – in this case, infrastructure and the many materialities that shape them. In turn, considering how these materialities have been shaped, what they do and how they shape and bound labour shows how this is a process always already human and non-human: a hybrid concept of labour that acknowledges the socio-materiality of the relations that make up the worlds we inhabit, and that remains attentive to the differences between them and seeks to explore them empirically.

As I will show, considering the lively materialities that both workers and infrastructure are embedded in enables an analysis that highlights the adaptability of the networked grid and the role work plays in this doing. The question of improvisation as a characteristic of infrastructural labour, in particular that of repair and maintenance, has been already explored (Graham & Thrift, 2007). Here I build upon that analysis by considering how workers respond to particular socio-materialities, which bound their labour and shape improvisation and its very possibility. In the case analysed here, I refer to the ongoing austerity that SACMEX has faced in the last three decades (De Alba, 2016; Morales, 2016); the worsening and shifting ground subsidence (Cabral-Cano, et al., 2008), which causes hydraulic infrastructures to break in ways that often go unnoticed; the overexploitation of the Mexico Valley and Lerma aquifers (Esteller & Díaz-Delgado, 2002; Maderey-Rascón & Jiménez-Román, 2001; Novelo & Tapia, 2012; Wester, 2009), which limits the amount of available water both now and in the projected future; and the rust and widespread breakdown that is common across hydraulic infrastructures in the City. These lively materialities are specific to Mexico City and its geography and history, highlighting the situatedness of labour and improvisation, and of the fixes that allow the grid to endure through adaptation. The focus on adaptation, its logic and the practices that enable it further contributes to literature on labour and infrastructure.

The focus on state workers and public infrastructure brings to the fore the question of state power and urban modernity and their maintenance and adaptation. The various practices and logics analysed in this dissertation work towards making these infrastructural configurations endure, adapting to socio-material changes; enabling the state to retain its grip over hydraulic infrastructures; and sustaining the promises of urban modernity amidst widespread breakdown and precarity. This is not to say that there are not challenges to state power and modern logics of nature appropriation and water production. Other groups advance their interests through diverse interventions and practices in and through hydraulic infrastructures. These often pierce the claims of centralised, complete state control over water and nature, and indicate that other ways of producing space and urban living are possible. However, these challenges and resistances do not necessarily equate to emancipatory logics or projects. As I will argue in Chapter 5, the claims made through infrastructures can be exclusionary, giving way to increasingly fragmented urban spaces and infrastructures. Beyond these relevant differences, the practices carried out by groups outside, and often against, the state and its workers also show how labour is central in making other infrastructural configurations. Whilst this dissertation does not look in detail to these groups and their narratives, actions, and logics, they are certainly crucial for a wider investigation of Mexico City's hydraulic politics.

Finally, in claiming a centrality to human labour, I do not seek to affirm that separations between humans and non-humans should be reinstated. Hybridity is characteristic of the worlds in which workers live and of the labour they perform. Infrastructures work by bringing together substances, practices, and processes that show how divides between supposedly discrete natural, social, political, historical, or quotidian spaces and logics are permeable and always already intertwined. That these processes come together does not mean that there are not numerous practices and processes that operate by separating them. As mentioned

earlier, law, science, technology, knowledge, politics, and their associated practices and narratives are continuously engaged with a task of separation. This is a fundamental tension of the modern world, and one that characterises too the Lerma System and the labour that works in and through its infrastructures. By focusing on how infrastructural and resource materiality, manual labour, and the many tasks of purification (Latour, 1993) that bureaucrats and experts carry out, I aim to further interrogate how hybridity unfolds, disentangling the work of humans and non-humans, and through this offering an explanation of how infrastructural configurations endure, change, and become entwined with non-linear temporalities and porous forms of power and inequality.

THE QUESTION OF URBAN WATER

The infrastructures that workers manage, operate, maintain, repair and adapt have their own histories, entwined with the urbanisation of nature in Mexico City and its paradoxes, limits, contradictions and characteristics. Here I introduce a brief history of water supply in Mexico City, focused on the Lerma System and its significance in the city's political ecology. The Lerma was instrumental in producing a new set of relations between city and nature through infrastructure. These follow from previous development and urbanisation pathways, whilst integrating new spaces to the urban political ecology of water urbanisation (González Reynoso, 2016). As mentioned briefly before, Mexico City's ecological history can be defined through its conflicting relationship with water, and with changing and contingent ways of producing it, both materially and symbolically. Often, accounts of how this urban environment has changed are articulated as a nostalgic narrative about a paradise lost – a city once built in harmony with nature and destroyed by the environmental action of the Spanish conquerors and colonisers. Whilst certainly the five-century long Spanish rule over the territory of what is today known as Mexico implied a profound transformation of Mexico City in relation to nature, it would be erroneous to presuppose a previously existing

harmony, or a moment in which nature was not already intertwined with the urban, politics, and society. Indeed, many hydraulic infrastructures that sought to produce a specific nature predate the colonial period and were in fact repurposed by the new rulers when they took control of the city (Legorreta, 2006).

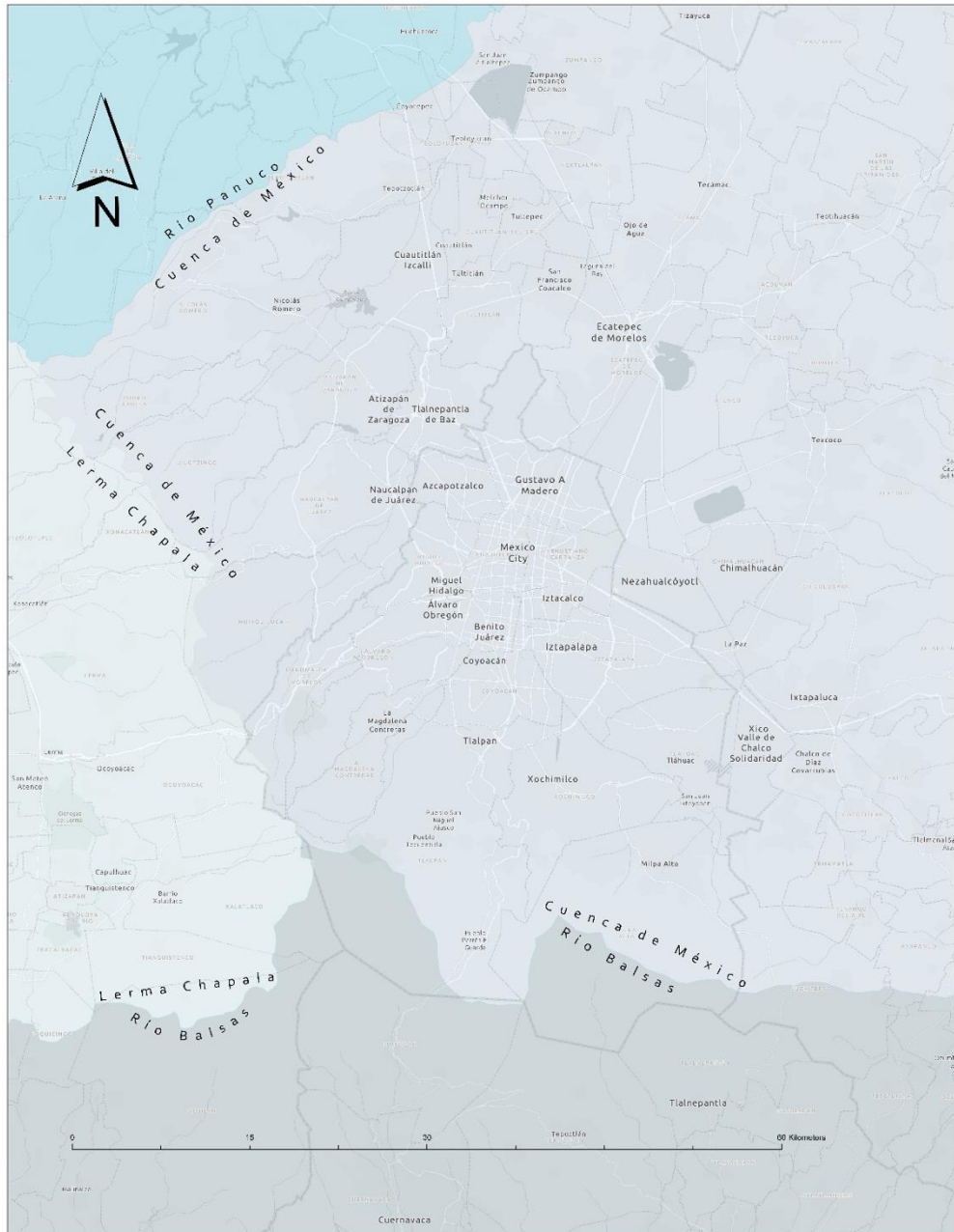
Certainly, this does not mean that there was not a profound change in the urban political ecology of the city in the aftermath of the Spanish conquest. Whilst this topic far exceeds the reach of this dissertation, some contextualising information might be useful and relevant. In her detailed study of the *Gran Canal del Desagüe*, Vera Candiani (2014) shows how one of the shifts that underpinned the task of desiccating the lacustrine system that covered most of the Mexico Valley was related to the question of land productivity and wealth. The economy of the pre-colonial city was centred on numerous relations of subordination and exchange between the diverse *altepetls* (city-states) that existed in the valley and beyond (García Chávez, 2007). At the same time, a complex system of raised fields (*chinampas*) constituted the bulk of agricultural productivity in the area, and fostered a series of relations between farmers, and wider societal institutions, practices, and processes (Morehart, 2016). Candiani argues that the urban environment envisioned, and ultimately produced, by Spanish rule was structured around a conception and practice of land as commercial, private wealth, and as a source of productivity linked to agricultural practices developed in Europe. Infrastructure, therefore, has been long central to the production of Mexico City's urban political ecology.

The *Desagüe* also aimed to avoid future threat and disaster. The city was prone to flooding, and still is, and this infrastructure was one that promised a final solution to this question. Demographic and economic growth, as well as the expansion of urban space, have led to the construction of numerous other drainage and sewage infrastructures across time, usually as promises of being a definitive solution to this and other entwined problems (Perló Cohen,

1989; Legorreta, 2006). Water is partially conceived and experienced as a threat to urban life, and to the diverse political, economic, and social, and symbolic relations that pivot around Mexico City. This is a concern that lives on, and that still informs many of the narratives that workers, engineers, bureaucrats, and politicians have about water and Mexico City and its present and future relations. However, this is not the sole role that water plays in the material and imagined environmental relations that make up the city as process, form, and lived space. The task of supply, as mentioned before, is also a crucial one. Its relevance is entwined not only with survival and physical supply but also with the projection and production of modernity and power, as it will be discussed in the following two sections. These requirements led to the construction of numerous infrastructures across time, which also imply making nature in ways amenable to the expansion of the urban process and form.

The rapid demographic and economic changes that followed the end of the Mexican Revolution (1910-1921, although these dates might differ depending on particular chronologies and geographical focuses of the armed conflict and its political aftermath) brought with them another expansion of the infrastructural networks that supply the city with water. The Xochimilco System had been inaugurated in 1911, but soon its output was insufficient to support a growing city. Since the 1930s, projects to supply Mexico City with water from neighbouring basins were being drafted. These will be explored in more detail in Chapter 4 of this dissertation. What I wish to highlight now is that the relation of the city with water had now exceeded the physical borders of the closed valley that once enclosed it. It did so through two different infrastructures. One was the *Desagüe*, already built by then, and the second would be the Lerma System. Today, Mexico City is connected to four different basins through diverse infrastructures: the Mexico, Lerma-Chapala, Balsas, and Pánuco basins (Map 1). This broader hydraulic infrastructural network has been recently

conceptualised as constitutive of the hydroplitan region of Mexico City (González Reynoso, 2016).



MAP 1. MEXICO CITY AND ITS SURROUNDING BASINS

As with the colonial expansion of Mexico City through desiccation and drainage, this new set of infrastructures deeply transformed the political ecology of water in the city. The ways in which they did so will be explored in detail throughout the dissertation. I will show how the

Lerma implied a further transformation of water, both materially and symbolically. Water was produced as an object independent from nature and the local relations it enabled and was transformed into a natural resource. This is related to a particular notion of what nature was and could be. Through the Lerma infrastructures, and indeed many others, water, and nature in general, was produced as an object to be known, dominated, and tapped. This was indeed a continuation of previous political ecological configurations, with some particularities. On the one hand, this domination was predicated on the purported accuracy of modern science and technology. On the other, it was paired with the broader societal and economic transformations that the Mexican post-revolutionary state had as its goals. The conquest of water, and its use to supply Mexico City, was now fundamental to the provision not only of modernity, but of the oftentimes conflicting promises of progress and social justice that the Mexican Revolution and the governments that followed it had made, partially through infrastructures.

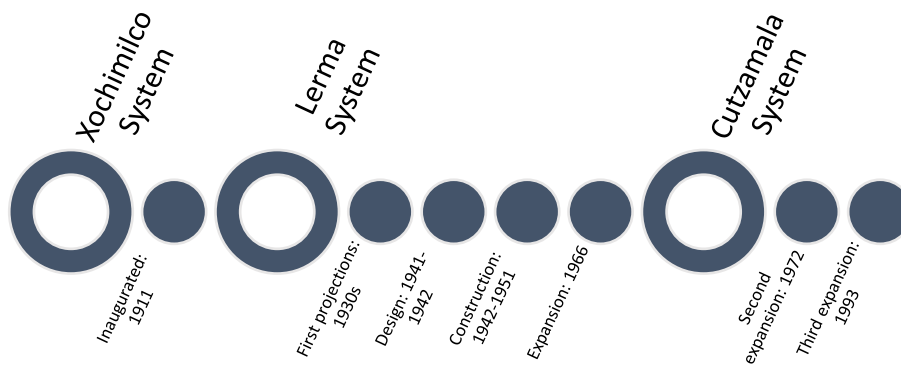


FIGURE 1. WATER SUPPLY WORKS IN 20TH CENTURY MEXICO CITY

After the Lerma, other interbasin transfers would be built. The main one has come to be grouped in the Lerma-Cutzamala System. This large infrastructural network has been built across three successive phases. The first one was the Lerma System, which became linked to other infrastructures after 1972. It was then when the waters of the Cutzamala River were tapped through several dams, aqueducts, and pumping stations, in what is known as the

Second Phase of the Cutzamala System. The third, and final one for now, was from 1993 onwards (Figure 1). It implied building several aqueducts and pipes adjacent to previously existing ones to increase water volume and facilitate infrastructure repair and maintenance. The Fourth Phase has been planned but not built, as it has encountered strong opposition from towns and communities that would be affected by the construction of new dams and aqueducts (Gómez-Fuentes, 2009). Still today, the question of securing supply sources is relevant for city governments, experts, and for workers, engineers and bureaucrats at SACMEX.

These concerns not only shape the development of large-scale infrastructural projects. They are also relevant for the everyday labour that sustains Mexico City's hydraulic infrastructures. As water was drawn from evermore distant sources and the Mexico Valley aquifer (which provides 44% of total water presently; see SACMEX, 2018), several environmental changes unfolded, which today shape hydraulic infrastructures and their operation, management, maintenance and repair. I have already mentioned some of the most salient ones, which are those explored throughout this dissertation. I refer to the socio-material processes of ground subsidence, aquifer overexploitation, and infrastructural decay and breakdown, both as a result of water flow and as a consequence of ongoing austerity. The everyday encounters with these lively materialities are shaped by the broader history of water supply as it has been briefly introduced here. They constitute the environment in which labour practices are carried out, both shaping and being shaped by them. They are the material unfolding of previous projects and processes of water supply and urbanisation. They are part of a situated political ecology that involves the material urbanisation of water and nature, but also the diverse forms of state power that seek to govern them.

INFRASTRUCTURE, LABOUR AND THE STATE

The relation between hydraulic infrastructures and the formation of state power in Mexico is a richly studied topic (Aboites Aguilar, 1998; 2009; 2012; Palerm, 2007; Romero Lankao, 1999). Here, I want to briefly overview its history in the last 150 years as a way to introduce the question of state formation, modernity and water. It has been shown that 1888 is a crucial moment in this process, as it was then when the promulgation of numerous laws that brought water under public ownership and management began. Even if these legal changes were often challenged by diverse local actors, including wealthy landowners and indigenous communities, the trend towards centralisation is clear (Aboites Aguilar, 1998; Camacho Pichardo, 2007). Linked to the consolidation of state power and an emerging bourgeoisie, hydraulic infrastructures were at the centre of the making of Mexican territory in the 19th Century (Perló Cohen, 1989; 1999), alongside other infrastructures such as railways and mining (Connolly, 1997).

This progressive and incremental control over water on behalf of the state served different purposes, linked to political economic disputes regarding the role of the state in modernisation and the relations between this process and those of capital accumulation and urbanisation. After the Mexican Revolution, emphasis was placed on irrigation and agriculture as a way to develop the Mexican countryside and to respond to the demands of the Revolution. It would not be until the end of the Lázaro Cárdenas presidency (1934-1940) that cities and the process of urbanisation would displace these concerns (Vitz, 2018). At the beginning of the Miguel Alemán administration (1946-1952), when the Lerma was completed, the shift was made material in the institutional makeup of the Mexican state. The former National Irrigation Commission (CNI) gave way to the Secretariat of Hydraulic Resources (SRH). Urbanisation, water management, and statecraft would become even more tightly entangled, only challenged after 1994, when institutions were designed to foster the

transformation of water into a fully-fledged commodity as part of a broader neoliberal transformation within the Mexican state (Aboites Aguilar, 2009).

Considering this broad history, the Lerma System and the labour practices that sustain it today are a productive site of inquiry. On the one hand, the Lerma was linked to a moment of capitalist modernisation, and to specific imaginaries of water, nature, city, capital and state, which I analyse in Chapter 4. These included the goal of progressively rationalising and strengthening the bureaucratic control over hydraulic resources as a way to produce state power and to simultaneously enable urbanisation and industrialisation. Whilst an evaluation of whether these goals were ever achieved or not is beyond the scope of this dissertation, I do interrogate how these imaginaries and forms of control are made enduring through everyday labour. This is certainly linked to the progressive austerity that has riddled SACMEX over the course of the last 30 years as part of a broader neoliberal moment, and to the ways in which labour becomes significant then as it sustains water urbanisation and state power through the constant work of operation, management and maintenance (Chapters 5 and 7), repair (Chapter 6) and file keeping and archiving (Chapter 4). This analysis builds upon research regarding infrastructure, state power and their relations on the everyday, both in the context of Mexico (De Alba, 2017; De Alba & Amaya, 2014; Meehan, 2014), and elsewhere (Anand, 2015; Barnes, 2014; 2017; Björkman, 2018). This dissertation contributes distinctly to this scholarship by querying what might be specific about overlooked forms of everyday labour.

In the task of supplying water through infrastructures, institutional relations and forms are also developed and maintained. In the case of Mexico City, research has shown how conflict between the city's government, the state of Mexico, and the federal administration revolves around questions of resource management and ownership (Perló Cohen & González Reynoso, 2005). In this dissertation, I show how institutional relations were made as the

Lerma was produced (Chapter 4), and how these, and indeed others, are maintained and adapted today through diverse bureaucratic practices (Chapter 7), including not only relations between different levels and offices of government but also within them. This suggests a close relationship between the construction and maintenance of infrastructures and the formation and reproduction of the state as a set of bureaucratic practices and institutions that seek to control, manage, and maintain resource supply and distribution. Crucially, these relations are also characterised by contradictions and paradoxes; by spaces in which water remains beyond the gaze and control of state experts, and by a heterogeneity that suggests that the boundaries of the state are enduring and adaptive, yet porous and always being challenged by both human and non-human practices and flows.

URBANISATION, CAPITALISM AND MODERNITY

The Lerma made material the pursuit of modernity as a spatial-temporal horizon. As it will be explored in Chapter 4, the engineers, bureaucrats, and politicians that were involved in its design and construction explicitly argued that this project would bring about a city where abundant water would be the norm. The modern future that was promised through the Lerma marched unstopably forward, to a thoroughly urbanised space, where the infrastructural state would support both urban living and growing industrialisation. At the centre of this task was Mexico City. Towards mid-20th Century, the capital was cementing its position as the country's political, economic, and cultural hub, in part due to a centralising strategy carried out by the Mexican state, its institutions, officials, and workers. Water supply was necessary to make sure this vision had any chance of becoming a reality and was also important in justifying the diverse processes of land acquisition, water appropriation, and infrastructure construction that underpinned this desired future.

As mentioned above, the pursuit of modernity implied the making of water into a techno-scientific object. Measurable, knowable, and usable, water was made into a resource, “a placeless, timeless ‘natural’ substance” (Banister & Widdifield, 2014, p. 37). This transformation required numerous intellectual, aesthetic, material, legal, and political interventions, which I explore in Chapters 4 and 5. To endure, modern water necessitates constant maintenance and management – a topic that I analyse particularly in Chapters 6 and 7. Making modern water requires separating nature from politics, engineering and society in law, knowledge, and bureaucratic narratives. That this separation is constantly challenged, showing how water is a hybrid process and substance, is unavoidably intertwined with the process of producing modernity (Latour, 1993; Swyngedouw, 1999; Gandy, 2014). These tensions are also present in the Lerma, where a desire to make water into a natural resource abstracted from place and time coexist with a series of processes and practices that often undermine this goal.

However, the horizons of modernity and modernisation surpass the question of nature. They are linked to at least two different processes, and to contentions around their definition and material production. I refer to the making of modern, liberal citizens, and to the relation between modernity and capitalism. These two are intertwined with the planning, construction, maintenance and repair of the Lerma System and infrastructures, and as such will be analysed throughout the dissertation. Regarding the former, José Esteban Castro has shown that the notion that access to water services as a universal right has been prevalent in Mexico, even if access remains unequal, constituting the material basis of many lived disparities in Mexico City, and as such “continues to be one of the unfulfilled promises of the Mexican Revolution” (Castro, 2004, p. 329). In this dissertation, I show how this inequality, already embedded in the very materiality of infrastructures (Duhau & Girola, 1990; Sánchez-Mejorada, 2005; Schwarz, 2017), is compounded by contemporary repair, maintenance, and

management practices. A study of labour practices and in through infrastructures shows how this fractured modernity (Gandy, 2002), the norm across cities in the Global South, requires work to endure and to sustain its uneven and unequal promises.

Paired with the goals of universal provision were those of supplying water for the progressive industrialisation of Mexico City. The Lerma is momentous as it materialises the capitalist agenda that became ever more firmly rooted in the Mexican federal government from the presidency of Miguel Alemán onwards (López-Portillo Tostado, 1995). The clarity with which water is made if not into a fully-fledged commodity, certainly into an input for capitalist modernisation and urbanisation, is visible in the Project itself, and analysed in Chapters 4 and 5. This transformation of water into a resource amenable to capitalist accumulation and industrialisation is linked to profound environmental transformations in the Lerma Valley and in Mexico City. Moreover, this task implied a particular function for the state, one which ensures that water is provided cheaply, abundantly, and constantly to industries in the Mexico Valley and in Mexico City in particular. How this urbanisation of nature sustains processes of capital accumulation has been thoroughly researched, particularly in critical urban studies (Arboleda, 2016; Gandy, 2002; Harvey D. , 1985; Heynen, Kaika, & Swyngedouw, 2006; Kaika, 2005; Smith, 2008; Swyngedouw, 2004). Here, I contribute to this topic by focusing not on the relations between capital and water and nature urbanisation, but mainly on those between the latter and everyday labour practices.

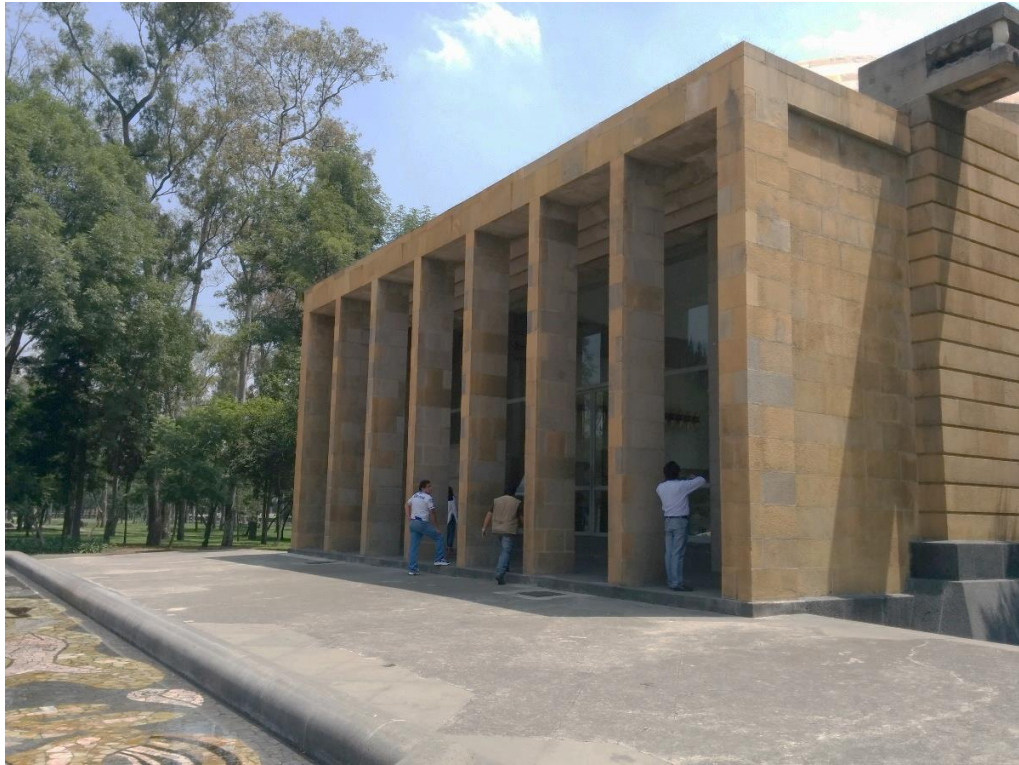


FIGURE 2. CONTESTED MODERNITIES: THE LERMA RIVER WATER DEPOSIT

The link between capitalism and modernity is not without challenge. During the construction of the Lerma System, other ways of imagining the future were being put forward. These are still visible in today's infrastructures, in particular in the River Lerma Water Deposit (Figure 2), where the System joins the wider Mexico City water grid. There, a mural painted by Diego Rivera imagines a future where the state serves as a mediator between classes, and provides water equally to all citizens (Tostado Gutiérrez, 2012). Rivera was putting forward a particular interpretation of the Mexican Revolution, closer to the populist moment that preceded Alemán, during the Lázaro Cárdenas administration. This was heavily informed by historical materialist readings of history, and as such was instrumental in depicting other pathways to modernity, in which capital accumulation was not central to the functions of the state. Instead, equality was put in the centre, challenging the liberal visions of citizenship I briefly introduced before. Whilst I will discuss these infrastructural aesthetics in Chapter 5, here I want to argue that the Lerma also shows how capitalist urbanisation and modernity

are not necessarily synonymous (Gandy, 2002), that other imaginaries were put forward at the time, and that they remain meaningful today. These alternative infrastructural imaginaries and practices certainly include monumental endeavours, such as the Diego Rivera mural, but also mundane interventions carried out on inconspicuous infrastructures, which often challenge ideal visions of modern infrastructure (Figure 3).



FIGURE 3. CONTESTED MODERNITIES: A CHAPEL AT A SACMEX FACILITY

The endurance of narratives and materialities of urban modernity is a central concern I explore in this dissertation. In particular, I suggest that the Lerma was not only central in

producing them as a forward-looking horizon in mid-20th Century Mexico. Still today, these practices, aspirations, and notions remain – partially through infrastructures and the work that sustains them. The Lerma carries into the present aspirations past, and allows them to be experienced, deployed, and transformed by urban dwellers, state workers and experts, politicians, and other groups who relate in various ways to water supply infrastructures in Mexico City. How this endurance is made, experienced, and challenged, and how it remains not static but changing and adapting is explored throughout the dissertation. The overarching claim is that the promises of modernity subsist through infrastructure, being not completely broken, but undoubtedly precarious, porous, and challenged constantly. The promises of equal access have indeed not been fulfilled, yet they are not definitely lost in a past long gone. They still make part of urban life and of the imaginaries put forward through infrastructure. Simultaneously, the role of the state in providing water to sustain and further the processes of urbanisation and capital accumulation remains, even if also precariously maintained through aging infrastructures, amidst dwindling budgets, and facing rapid aquifer depletion. Here too the role of everyday labour is crucial, as I will show throughout this dissertation.

DISSERTATION OUTLINE

Chapter 2 further develops the theoretical arguments presented in this introduction, placing this work within the growing literature on infrastructures in the social sciences. I review contributions coming from critical political economy and ecology approaches, science and technology studies, and ethnographic accounts of infrastructure, specifically in cities and countries of the Global South. I focus on how infrastructures have been theorised, discussing questions of hybridity, and human and non-human agencies. I also analyse how nature, cities and urbanisation, and the state have been researched through infrastructures across these different standpoints. Finally, I focus on the question of labour, particularly that of repair and

maintenance – a field that has been gaining traction lately across the social sciences. I show how my dissertation engages with these bodies of scholarly literature, and advances arguments regarding the role of labour in and through infrastructures, and how this conceptualisation can become a critical standpoint to interrogate and explore the relation between infrastructures, state and nature, and urbanisation and modernity in Mexico City.

Chapter 3 presents the methodological approach that underpins this work. I describe how I approximated the question of researching infrastructures ethnographically (see Starr, 1999). In particular, I focus on how labour informs this, and I show how work became not only an object of analysis, but a methodological tool. I do so by presenting numerous ethnographic vignettes, through which I aim to show how I conducted fieldwork, how I positioned myself throughout it, and how both my fieldwork practices and positionality inform this dissertation. I reflect on how I became increasingly involved in carrying out manual work alongside the work teams, arguing that this material, sensuous action is relevant in analysing how labour relates to infrastructure in the Lerma System. As part of this reflection, I elaborate on how I consider questions of aesthetics and materiality. I also discuss how I approached the archives that I analysed in Mexico City, understanding them not as spaces where objective data can be found but rather as sites that are also being shaped by the interactions between labour, infrastructure, and diverse human and non-human agencies. Finally, the chapter develops the analytical strategy that informs this dissertation, which follows a labour-centred situated approach.

Chapter 4 shifts focus and delves into empirical data, in particular that which concerns archives, archiving, and archival material. There, I analyse how present and past archiving practices, different formal and informal archives, and the files these sites hold shine light into the role of labour in making infrastructure into a stable object that can be managed and known. At the same time, I explore how the Lerma was shaped by diverse forms of

knowledge and expertise, and how these are relevant to understand the everyday making of the state, the city and urban water. I place these forms of doing and knowing within broader infrastructural imaginaries, which I analyse also through archival and historical data. I also suggest that these imaginaries are not only relevant to understand the past but are also playing a fundamental role in current archiving practices, in particular those informal ones that exist throughout SACMEX offices. Archives allow for an exploration of how the state exerts control over infrastructures, both historically and contemporarily, and, at the same time, are crucial in understanding how workers and bureaucrats make claims on the present value of their labour insofar it is a continuation of past efforts to supply water to Mexico City.

Chapter 5 introduces the analytic of infrastructural aesthetics. I develop it in a threefold way. First, it refers to the modes of experience that infrastructures enable. Second, it concerns the material production of this aesthetic dimension through infrastructure, focusing on the role of labour therein. Finally, it deals with the material form of infrastructure itself, always a result of ongoing work practices and central in enabling different modes of relating to infrastructure. The lens of infrastructural aesthetics as a way of experiencing the world through manifold relations with infrastructures, and always already sustained by a plurality of labour practices, allows me to explore questions of state power, nature urbanisation and urban inequality as they unfold and shape space. At the same time, attention to alternative, and often informal, infrastructural aesthetics permits an exploration of how state power and urban modernity are challenged, exceeded and resisted.

To explore these topics, I further develop the analytic of infrastructural aesthetics through the concept of aesthetic registers. This is a heuristic device that holds the experiential, productive and material dimensions of infrastructural aesthetics together, allowing an empirical and conceptual exploration of how they come together in everyday interactions between infrastructures, materialities, and urban dwellers and workers. I focus on three

aesthetic registers made up through the productive contradictions between visibility and invisibility; monumentality and mundanity; and formality and informality. I argue that an empirical exploration of these registers and how they are produced, maintained, and challenged is a useful standpoint to analyse the making of state power, modernity, nature, and urban life through infrastructures. Infrastructural aesthetics are outcomes of diverse practices carried by workers, experts, urban dwellers, private companies, and other groups and individuals making claims on infrastructures, as well as by infrastructure's decay, ruination, and breakdown. This implies that aesthetic registers are not static but in flux. Ethnographic attention to these processes highlights this fluidity, its many contradictions, and the role of labour therein.

Empirically, I focus on four sites. The first one is the Lerma Distribution Chamber, where the Lerma System has its monumental endpoint at the fountain and deposit painted by Diego Rivera and designed by fellow communist architect Ricardo Rivas. The second is the Almoloya Pumping Plant, an equally monumental infrastructure in which the aesthetic discourse is not one centred on making visible the process of nation building and state making but on obscuring how water is made into a natural resource. The third one is the Reforma Well, a mundane, invisible site in which alternative connections to the grid have been made, enabling a particular aesthetic register that challenges state power and control over water. Finally, I analyse how the Lerma aqueduct is kept from the sight and control of the Mexico City government at the upscale Bosques de las Lomas neighbourhood, in west Mexico City. There, urban elites have claimed control of urban space not only above surface but also below. The ways in which they control and survey infrastructures challenges state power and operates through diverse class and race inequalities associated with workers' positionality and labour in monitoring and repairing infrastructures. These suggest that both elite and

marginal informalities are relevant in understanding how infrastructures and their aesthetic registers shape urban life, and state control over nature and the city.

Chapter 6 narrows its view on the question of manual labour. In particular, it focuses on the repair work that diverse teams carry out across the Lerma infrastructures, both in Mexico City itself and in the neighbouring Lerma Valley. The emphasis on repair as a distinctive practice moves forward recent analyses of repair and maintenance (Alda-Vidal, Kooy & Rusca, 2018; Baptista, 2019; Barnes, 2017). By exploring repair as the specific labour that follows breakdown, different from maintenance practices, which seek to avoid it, and operation ones, which are concerned with maintaining flow, I shed light on how labour enables not only the endurance but the adaptation of the formal grid. I conceptualise this form of work, and the logic of adaptation that it makes material, as patchwork, following workers' own descriptions of their labour. Patchwork is an incremental (Silver, 2014) practice, which relies on infrastructures' convertibility (Simone, 2004a) and the creative and improvisational action of workers (Graham & Thrift, 2007).

Whilst these practices have been analysed thoroughly amongst informal dwellers in cities of the Global South (Simone, 2015), the stakes of patchwork as a practice carried out in the formal grid are yet to be explored. Here I do so, showing how patchwork allows the grid to endure amidst ongoing decay, progressive austerity, and in a mutually determining relation with the lively materialities that make up Mexico City's soil, water and infrastructure. In doing so, these practices do not prefigure other urban politics and forms, but rather allow an unequal and uneven one to endure through constant adaptation. Central to the maintenance of state power over infrastructures and urban life, patchwork is also necessary for the promises of urban modernity to endure, even if porous and under constant challenge. Without these adaptive labour practices, water supply would breakdown, and the ideals of constant piped supply would falter. However, patchwork is unable to fix the profound

inequalities that characterise a fractured modernity (Gandy, 2008) in Mexico City (Duhau & Girola, 1990; Sánchez-Mejorada Fernández, 2005). Instead, their labour often reproduces and deepens these spatial inequities, often against workers' wills.

Chapter 7 also focuses on labour and expertise practices and logics, albeit not on those carried out by manual workers. Instead, it analyses how engineers and bureaucrats seek to make the Lerma System infrastructures and water flows manageable. This task is in various ways a problem of managing the unknown. Plans are outdated or do not exist; calculations are not accurate and are often expressed in vernacular metrics that do not comply with universalist notions of how to measure water flows and levels; leaks and other losses proliferate and remain unaccounted for; modernisation and automatization projects lay incomplete as budgets deplete and SACMEX administrations change; and the surveillance and management capabilities of engineers are stretched and become insufficient as personnel decreases and the grid expands. I suggest that it is the problem of unknowability what shapes much of water management in Mexico City, as these state experts often resort to memory, calculation, speculation, and affect to fill the gaps that exist in formal, purportedly accurate, information and knowledge. I show how, without this practical knowledge, it would not be possible to make the water grid stable, water an object of measuring and control, and the state as the set of institutions that seek to control and operate these infrastructures.

To analyse these claims, I look at three different instances of managing the unknown. The first one refers to the gaps in formal representations of the water system, in particular maps and plans. I explore how workers and engineers use their memory of the grid, the city above ground, and their past labour to fill them. In doing so, they are not producing an ostensibly precise image of the water network but rather one that is sufficient to allow them to carry out their work. This shows how expertise is produced relationally through infrastructures

and the city, and how it often reinforces inequalities that are present in urban space. The second instance is that of measuring water levels. I show how engineers and workers resort to vernacular metrics that make water knowable, even if not through universalist metrics. A different set of bureaucrats and engineers is tasked with translating these measurements, and with controlling infrastructures, often from afar. These tasks are characterised too by diverse ways of bridging gaps between the known and unknown. As workers in charge of surveying infrastructures are unable to monitor them either remotely or personally, they must rely on other workers and on infrastructures themselves, highlighting the role of trust in managing Mexico City's water network. Finally, I conclude by arguing that these tasks are those that make possible managing the Lerma System, reproducing state control and power, even if the question of the unknown is always exceeding the techniques, strategies, and practices workers and experts deploy. This shows that, far from being unassimilable for purposes of statecraft, practical knowledge – at least that of workers and engineers – is fundamental in its making, maintaining, and adapting.

2. CONCEPTUALISING INFRASTRUCTURE AND LABOUR

Qualitative approaches to the study of infrastructure have proliferated immensely since Susan Leigh Star's seminal text 'The Ethnography of Infrastructure' was published (1999). Her call to study 'boring things' has been, by all measures, incredibly successful. From the study of information systems, infrastructure has expanded, becoming a key concept across disciplines and objects of study. Pipes, dams, roads, electricity grids, meters, sensing devices, and many more objects and processes have been analysed in this growing field of infrastructure studies. Geographers, sociologists, political scientists, anthropologists and many others are now actively researching infrastructures across different scales and times. Despite this expansion, a fundamental insight from Star's research remains in place: that infrastructure is not a thing but a relation. This relationality calls attention to the ways in which it becomes part of the making of socio-material processes, both historically and on the everyday; how it is perceived and used by different groups; how it links events, sites, temporalities and practices; how it is shaped and shapes practice, and how it implies numerous local arrangements to function. Similarly, Star's argument for an ethnographic approach to study infrastructure is at the core of much current scholarship on the subject. Attention to plurality and paradoxes, the surfacing of otherwise invisible work, and the study of infrastructure's design are still main tenets of contemporary research.

This dissertation engages with this body of literature by analysing the role of human labour in documenting, operating, managing, maintaining and repairing infrastructures. In doing so, it sheds light on the question of work, which, despite growing attention (Alda-Vidal, Kooy, & Rusca, 2018; Anand, 2015; Baptista, 2019; Barnes, 2017; Björkman, 2018; Denis & Pontille, 2014; Graham & Thrift, 2007), remains comparatively unexplored and undertheorized. As I will argue in this chapter, a potential way forward is to consider the specificity of human

work in light of the previously mentioned work, and of theorisations about infrastructure's hybridity (Gandy, 2005; Swyngedouw, 2006) and the question of more-than-human agencies (Meehan, 2014) and efficacies (Tonkiss, 2015). Building upon Marxian approaches to the question of labour and infrastructure (Arboleda, 2017; Kirsch & Mitchell, 2004; Loftus, 2007), object-oriented critiques of this strand of materialism (Bennett, 2010; Latour, 1993) and ethnographic studies of infrastructure in cities of the Global South (Anand, 2017; Björkman, 2015; Silver, 2014; Simone, 2004a; 2004b; 2013; Zeiderman, 2016; von Schnitzler, 2008), I elaborate on a critical approach to everyday work that conceptualises its specificity and role whilst upholding notions of hybridity. This approach mobilises early Marxist conceptions of labour as practice and process (Marx, 1993) and theorises from Mexico City and the experiences of workers at SACMEX and from how matter matters (Bakker & Bridge, 2006) in bounding and shaping their labour, whilst being shaped by it. This is a relational approach to labour that complements an equally relational conception of infrastructure.

In what follows, I lay out how this theoretical argument draws upon and engages with existing literature on infrastructure and its relations to nature, state, city and labour. I begin by defining infrastructure as a hybridising process and object, through which social and material relations are simultaneously made and brought together with others that were previously disconnected. This definition draws on current research on the topic, as well as on the findings presented in this dissertation. It also engages with debates around the question of human and non-human agencies and their role in the making of socio-material relations, and proposes to explore this issue empirically through the conjoint research of infrastructure and the various labour practices that are required for it to function and endure. Bearing in mind this definition, I then discuss in more detail diverse contributions regarding the hybridity of the city and the urban process, focusing on contributions that interrogate critically the question of socio-materialities, the cyborg, and urban political

ecology in diverse scholarly traditions. Finally, I review some main contributions stemming from ethnographic studies of urban infrastructures, highlighting how they show that the relations they bring together are characterised by multiplicity, change, and precarious stabilities.

The second section focuses on the notion of infrastructural configuration, central to this dissertation. An infrastructural configuration is defined as a temporal and spatial congealment of particular socio-material relations through infrastructures. The notion of congealment certainly does not imply stasis but a continuity of the distributional and institutional relations that characterise the interactions between infrastructures, nature, the state, political and social projects, process, and practices. Infrastructures are central in the making of this endurance and analysing them becomes a way to research how socio-material relations become stable across time and space. To develop this concept, I critically discuss works in urban political ecology, analysing how the relations between infrastructures, nature and the city unfold. Afterwards, I query how the everyday relations between modernity, the urban question, and capitalism have been analysed. I highlight how the analysis of urban infrastructures can offer insights into the production, maintenance and unfolding of urban modernity. This leads to a short discussion of how the role of the state in these set of relations has been analysed, both in relation to modernity and the urbanisation of natural resources. Finally, I recapitulate what the concept of infrastructural configuration entails, and what it does in this dissertation.

In the final section, I elaborate on the question of labour. I start by discussing how this work relates to the literatures mentioned before – repair and maintenance studies, Marxist approaches to labour and ethnographic studies of infrastructure in cities of the Global South. Building upon them, I advance a definition of labour as a relational practice and process that is always bounded by the lively materialities of infrastructure and other flows such as soil,

water and rust. This definition acknowledges the hybridity of urban worlds, yet it claims a specificity to human labour insofar it is through it that complex infrastructural systems can adapt to ongoing socio-material change through creative, improvisational and incremental (Silver, 2014) work. This definition emerges not only from critical readings of existing literature but also from the daily practices of workers across SACMEX. It therefore takes Mexico City as a site of theorisation, considering its geographical and historical characteristics as at depth, without this meaning that this relational logic might not be at work elsewhere. I suggest that these geohistorical specificities might be better accounted for if considering how matter matters (Bakker & Bridge, 2006) in shaping and bounding everyday labour and its interactions with infrastructure amidst ongoing austerity, soil subsidence, water scarcity and breakdown and material decay. The theoretical analysis of labour concludes this chapter and sets the stage for the methodological and empirical analyses that follow.

CONCEPTUALISING INFRASTRUCTURE

HYBRIDITY AND SOCIO-MATERIALITY

Social science studies of infrastructure have shown how these are necessary in the making and reproduction of social, political, economic, technological, and material relations, spaces, institutions, and processes. Instead of being thought of and described as discrete spheres, studies of infrastructures argue that these unfold and are made simultaneously, their intertwinement so deep that the long-held separations of technology and politics, society and nature, and indeed many others, are profoundly questioned. Research that puts the infrastructural question at the centre of enquiry has developed numerous concepts to describe the fundamental characteristics of these entanglements, such as socio-natural (Swyngedouw, 1999), socio-material (Carse, 2012), or technopolitical (Barnes, 2014), amidst many others. By highlighting the question of hybridity, these works are in a productive and

critical discussion with the plural body of research often defined under the umbrella term of 'new materialism' (Latour, 1993; 2005) or object-oriented approaches to social science (Bennett, 2010). Simultaneously, there is a rich exchange with critical perspectives on political ecology (Kaika & Swyngedouw, 2000; Gandy, 2002; Swyngedouw, 2004; 2015; Heynen, Kaika, & Swyngedouw, 2006; Loftus, 2007), and with ethnographic urban studies on and from the Global South (Simone, 2004b; 2004a; von Schnitzler, 2016; Anand, 2017; Bhan, 2019).

Empirically, this infrastructural turn navigates and brings together different geographical and sociological scales and topics. An integral part of its theoretical proposal is to bring to the fore the relations that exist, for example, between the domestic realm and the political ecologies of urban regions (Kaika, 2004; 2005). Numerous volumes have questioned the topic of citizenship, and the role of diverse infrastructures – hydraulic, electricity, sanitation – on its making as a substantive and not merely a formal category (von Schnitzler, 2008; Anand, 2011; Zeiderman, 2016; Fredericks, 2018). Others have contributed to the analysis of the city, society, and nature as imbricated processes and spaces, produced simultaneously through numerous infrastructures (Graham & Marvin, 2001; Gandy, 2002; 2014; Swyngedouw, 2004). Finally, and without being in any way exhaustive, infrastructural studies have analysed the making and reproduction of the state and state power from the scale of local relations (Meehan, 2014) to the material and symbolic space of the nation-state (Harvey & Knox, 2015; Swyngedouw, 2015; Barnes, 2017). Throughout these works, infrastructure emerges as a powerful concept to interrogate the making of multiple socio-material relations that traverse space and bring together complex, fluctuating temporalities (Appel, 2018; Harvey, 2018), becoming entangled in the making and enabling of numerous affective (Berlant, 2016), and aesthetic (Larkin, 2018) registers, processes, and practices.

But what exactly is infrastructure? Throughout the aforementioned contributions, and indeed others that take infrastructure as “a material thing, a bundle of social relationships, and an analytic” (Carse, 2017a, p. 891), some fundamental characteristics can be identified. The first one is that infrastructure underlies the historical and spatial development of socio-material processes. In this regard, it has been argued that infrastructures are “foundations of larger scale social forms, including patterns of social integration and fragmentation, uneven geographical development and collective social imaginaries.” (Angelo & Hentschel, 2015, p. 306). Infrastructure alludes “to the vast, complex, and changing systems that support modern societies and economies.” (Carse, 2017b, p. 27) Chief amongst them are the conjoint processes of capitalist development and urbanisation, where infrastructures too are fulfilling a fundamental role in their making and reproduction (Harvey D., 1985; Graham & Marvin, 2001; Gandy, 2014). Material infrastructures, moreover, not only lie at the basis of processes and projects such as modernity, development, or capitalism but also are constitutive of differentiated experiences of everyday life. Connection and disconnection from water, electricity, transportation, and communication infrastructure networks are productive of unequal ways of inhabiting and experiencing the world (Harvey & Knox, 2015; Silver, 2015; von Schnitzler, 2016; Anand, 2017).

Another characteristic of infrastructure is its relationality. Infrastructure materially and symbolically links together distant places, constituting the fabric of space itself (Gandy, 2014). This is certainly the case of urban form and process, itself constituted by numerous infrastructural networks and the diverse flows they enable (Gandy, 2005). Moreover, infrastructures not only connect diverse spaces, but also different temporalities. They do so in manifold ways. On the one hand, they are crucial in speeding up the metabolic flows of resources and information, or in achieving the ‘time-space compression’ that characterises capitalist development (Harvey D., 1990) and urbanisation (Arboleda, 2016). On the other

hand, infrastructures “are critical to both differentiated experiences of everyday life and to expectations of the future.” (Anand, Gupta, & Appel, 2018, p. 3). They are the material and symbolic conduits through which promises of the future are made, and their decay and breakdown is closely links to the material and social lives of diverse projects and processes, such as modernity, capitalism, or the nation. Infrastructures therefore constitute both the substrate of historical processes and everyday life and do so in a way that brings the production and reproduction of both together, intertwining not only space but also multiple temporalities. Space and time are not merely contextualising processes outside infrastructures but made in and through them (Latour, 1987).

Following these contributions, I define infrastructure as a hybridising process and material object, through which new socio-material relations are produced, already existing ones are bundled in new configurations, and their entanglements are maintained and adapted through time and space. This definition highlights how infrastructure is an ongoing process, which does not have a neat beginning and end, but it is instead ongoing and everchanging. This is what the notion of hybridising entails, being a dynamic process, characterised by constant movement, fluidity, mutability, and change. Stability, if and when present, is not given, but rather a precarious achievement (Graham & Marvin, 2001; Domínguez Rubio, 2016; Baptista, 2019). The definition also emphasises the role of infrastructure in producing new relations but acknowledges that many of the ones that specific networks bring together might have already existed before, even if their coming together implies new political, environmental, spatial and social configurations. Crucially, it posits that these relations are not self-sustaining. Instead, they need constant repair, maintenance, operation and management. It is in this reproductive moment where I query the role of human labour, as it allows for a critical exploration of how infrastructures, and the relations they enable, endure and adapt to ongoing change.

This approach takes on board the critiques posed in new materialist approaches to the social, by exploring the role of humans and non-humans in it, and not attaching causality to forces unseen and yet acting through infrastructures (Latour, 1993). However, it does not affirm that there is a symmetry between these agencies, or efficacies (Tonkiss, 2015), and rather takes this question as an empirical one. To do so, here I aim to present data by richly describing the materialities of infrastructure and other flows as they become relevant to workers across SACMEX. This is a mode of narration inasmuch it is a work of conceptualisation. It seeks to convey the liveliness of the socio-material objects, relations and processes that shape and bound workers' labour, showing how material flows, blockages, memories, futures and presents often escape calculation, control, prediction and pre-emptive action. Human labour is crucial insofar it enables always partial forms of knowledge, response, speculation and management to be deployed as a process and practice that, as infrastructure, is always ongoing, unfinished and in constant change. Workers, and the material world in and through which their labour is carried out, are entangled in dense mesh of relations that is mutually shaped and vital to grasp how the worlds we inhabit come into being.

HYBRID CITIES

Infrastructures are profoundly entangled with the making and experience of inhabiting the city. They play a central role in producing urban space and in mediating the relations that shape the experience of inhabiting them. The most basic urban flows and experiences are mediated and enabled through infrastructures, from the scale of the body to the many networks that spread outside and across the city. Infrastructures are therefore constitutive of the urban as a process characterised by manifold flows, including those of capital, resources, energy, and people. The relation between cities and infrastructures has been increasingly conceptualised as one that is not easily divisible, their intertwinement so

profound and fundamental that it has been argued that both “are seamlessly coproduced, and co-evolve, together within contemporary society.” (Graham & Marvin, 2001, p. 179) However, behind this widely shared point of agreement, which assumes and puts forward an increasing co-determination of infrastructural forms and networks and cities and urban processes, many differences lurk. These link back to the question of hybridity, and to the diverse ways in which humans and non-humans act. Whilst the relevance of infrastructures is hard to understate, the theorisations of the work they do, and the ontological accounts of what they are and how they shape cities and urban living greatly differ.

On a fundamental level, infrastructures can be thought of as the material substrate that constitutes what cities are. As the very prefix implies, the work they do is carried out in the underbelly of the city, ideally kept invisible whether purposefully or as a result of the historical processes through which urban space is made. Even if this invisibility has been put into question through processes of infrastructural unbundling in the Global North (Graham & Marvin, 2001; Graham & Thrift, 2007), and has been much less salient in cities in the post-colonial Global South (Gandy, 2014), the notion that infrastructure conceals certain flows has been well-established in academic literature (Kaika & Swyngedouw, 2000). In many of these accounts, following infrastructures allows for a reconstruction of how certain hybrid processes take place, and can be deployed as a conceptual and analytical tool to critically explore political ecologies and economies in urban space (Gandy, 2002; Swyngedouw, 2004; Heynen, Kaika, & Swyngedouw, 2006; Loftus, 2007). In these, differences notwithstanding, infrastructures are hybridising processes and objects always embedded in and part of the making of historical processes that traverse the urban space, linking it to regional, national and even global processes, and back to the household and the body (Kaika, 2004; Gandy, 2005).

However, in other accounts of what cities are, infrastructures are conceptualised not only as the material that makes the city. One of such examples is Ash Amin and Nigel Thrift's 2017 book *'Seeing Like City'*. There, the authors argue that infrastructures are not mere materiality or conduits for flows of power and substances occurring elsewhere. Instead, they are actants that shape space and the social through their absences and presences. Humans, other living beings, and multiple flows of energy and resources are intertwined through them, making the city a living space that is hard to apprehend and predict. In this coming together, infrastructures are enabling the becoming of new urban forms, in a process that makes the city not only irreducible to an outcome of previously existing processes, but very much alive, even independently of humans and human cognition. This approach to the question of cities and infrastructure eschews the possibility of macro urban theories, and instead calls for an open approach that brings together disparate disciplines and practices. Moreover, it calls for a reconsideration of how to make infrastructures and infrastructural provision the centre of urban policies that seek to recreate a new, more equal urban publics.

Other works have put forward the notion of the city as a cyborg – defined as “a hybrid creature, composed of organism and machine” (Haraway, 1991, p. 1) – or cyborg urbanisation (Swyngedouw, 1996; 2006; Gandy, 2005). In these works, the city is conceptualised as a hybrid, in which technology, politics, nature, society, culture, humans and non-humans are brought together, with infrastructures being also fundamental in these entanglements. Moreover, the cyborg city is a particular kind of hybrid that is shaped by several historical processes and their transformations towards the end of the 20th Century, in particular those related to the development of technological networks, including many digital ones, and their intertwinement with all aspects of the urban process and urban life (Gandy, 2005). In a cyborg city, coherence and regulation gives way to constant boundary blurring and transgression. At the same time, the cyborg notion suggests that the

hybridisation that characterises contemporary urbanisation is not only a description of how urban processes and forms are made and unfold, but even of how the human body is being constantly reworked through the interaction of technology and the city. Moreover, the complex lines through which connection or disconnection to these hybrid forms are structured in the contemporary city are reworking and deepening forms of exclusion and marginalisation. Similarly to Amin and Thrift's notion, infrastructure, as a concrete materialisation of the cyborg, is how these exclusions and the margins are made and experienced (Lancione & McFarlane, 2016).

In the cyborg notion the productiveness of infrastructures is present, yet its vitalist or machinic aspects are not as central as in other contributions (Amin & Thrift, 2017). This certainly does not mean that infrastructures are always just materialisations of power residing elsewhere but that enduring flows and relations matter both for analytical and experiential purposes. Amongst them, those that make up the processes, practices, and dynamics of resource making and distribution, or urban political ecologies, are of great relevance (Heynen, Kaika, & Swyngedouw, 2006). In these works, the notion of the cyborg is deployed not so much to explore how the bodily experiences of the city have been shaped through the intertwining of technology, urbanisation, and nature, but to explore the making of urbanised resource and the politics of their unequal distribution. Carrying forward insights stemming from Marxist approaches to the questions of nature, space, and the city (Harvey D., 1985; Smith, 2008), cyborg urbanisation is an analytical term that describes and critically explores the circulation and metabolism of resources and flows of capital in the urban process and in urban space (Swyngedouw, 2006). In this view, infrastructures become central not only for capital accumulation, as sunk capital itself, but also as the networks that allow natural resources, capital, and labour to flow, come together, and reproduce capitalism not

only as an economic system, but as an ecological one of which cities and the urban process are a fundamental element (Moore, 2015; Arboleda, 2016; Gandy, 2018).

In this dissertation, I discuss these questions through the concepts of hybrid and socio-material, here used interchangeably, as both of them refer to the ontological coming together of humans and non-humans in multiple and fluctuating ways. Following my definition of infrastructure as a hybridising process and object, I elaborate on theorisations of the relation between cities and infrastructure, arguing that indeed these two develop in tandem. Cities are certainly made up of numerous flows enabled by infrastructures, including resources, capital, and people, and constitute its built environment. However, they are part of other processes that exceed this functionalist account, and the socio-material relations they bring together cannot be reduced to mere reproduction of power residing elsewhere. As I have already pointed out, infrastructures also enable relations other than those of urban political ecologies, being central to the experience of numerous aesthetic, affective, technopolitical and social registers. This enabling further compounds the fact that infrastructures are relational processes and objects, which are part of the making of hybrid cities and the experiences in and of them. In partial agreement with Amin and Thrift (2017), I also argue that these relations can indeed take place far from the knowledge and sight of human actors; think, for example, of the many leaks that proliferate beneath urban spaces across the world, and of the fact that they can remain unknown and unknowable for indeterminate periods of time.

Despite this, I do not argue that infrastructures are productive themselves of new urban processes and experiences. Rather, it is through the interaction between labour, and infrastructural projects, their historical unfolding, their many subversions, resistances, breakdowns, and decay that material infrastructures, and the processes and practices they enable, can become productive of new hybrid relations. By focusing on the interactions

between infrastructure, as material objects that carry with them the force of geohistorical processes, and everyday labour, not only questions of continuous production are brought to the fore. Simultaneously, it becomes possible to critically explore how processes and projects are reproduced, transformed, and adapted, whilst avoiding mechanistic accounts of historical necessity and teleology. Said processes certainly include the *longue-durée* projects and processes of modernity and capitalism, variegated geographically and historically as they are across the unequal and uneven landscapes of the globe. However, they also comprise the new configurations that are made through infrastructure's hybrid relationalities, and that are indeed often unforeseen, even if not necessarily unforeseeable, to human cognition and practice. Cities are spaces in which these continuities and disruptions play out and are lived. However, as an analytical lens they might become unmanageable, as networks, flows and traces proliferate and disperse. It is here where an ethnographic approach to infrastructure as constitutive of and constituted by the urban as process, lived experience, and form, can be useful in exploring how these objects and processes unfold, and how they become entangled with other hybrid relations across space and time.

ETHNOGRAPHIC APPROACHES TO URBAN INFRASTRUCTURES

Ethnographic studies of urban infrastructures shed light on the fluidity and multiplicity of urban processes and lives. They highlight how the stability of socio-material relations is often precarious, and highly differentiated across space and time. These works highlight the plurality of urban processes and experiences and take situated specificities as a site of rich theorisation. This dissertation's approach, both in terms of theory and method, follows this body of research, particularly that which focuses on cities of the Global South. These contributions have shown how the processes of resource making and distribution, the production of citizenship, and the very practices through which people make life possible in cities are all mediated, and often made, through infrastructures. Far from the integrated

networks that constitute the historical experience and narrative of urban modernity in the Global North, cities in the Global South are characterised by heterogeneous configurations, marginal practices, and infrastructural inequalities that can often be traced to the trajectories of colonial and postcolonial divisions and relations (Roy, 2005; von Schnitzler, 2008; Gandy, 2014; Silver, 2014; Zeiderman, 2016) even if this splintering has been unfolding in the Global North as a result of the deepening of austerity policies in neoliberal times (Graham & Marvin, 2001).

This dissertation engages particularly with discussions and debates on infrastructures in relation to the making and distribution of urbanised resources, in specific water. Research on hydraulic infrastructures has shown how through them not only are nature, society, and politics brought together, but also how they shape urban life from the scale of the body to the political ecological relations that constitute urban regions. In his research on Mumbai, for example, Nikhil Anand has shown how hydraulic infrastructures are crucial in the production of the city as shape and as lived experience. Through an ethnographic account that focuses both on the human and the non-human, he has shown that infrastructures are active makers of urban hinterlands and centres, of their many inequalities, of the citizen as practice, and of class as both an embodied experience, and a social relation (Anand, 2017, p. 37). In Mumbai, and indeed in other cities across the world, including Mexico City, hydraulic infrastructures are also part of the making of time, as supply rationing organises household and social activities, of the body as a political relation, and of collective and individual political action (Schwarz, 2017).

Access to water has also been argued to be entangled with the making of hydraulic citizenship, defined as “the ability of residents to be recognized by city agencies through legitimate water services” (Anand, 2017, p. 8). The word ability is not without intention. Citizenship here is not something that is given through law or norm, but rather a status that

is accomplished by residents through hydraulic infrastructures, and that needs to be constantly affirmed, negotiated, and produced. The ways in which citizens make this material and symbolic claim often exceeds the concepts and tools of liberal democracy and can include the hybrid networks that are constituted through patronage, kinship, and other socio-material relations. Here, residents are active makers of their status as citizens, and of urban hydraulic infrastructures themselves. This performative condition of citizenship, which is accomplished through material engagements with the state, can be useful in thinking how infrastructures are embedded in the production of diverse polities, which often stretch and challenge liberal and modern conceptions of citizenship, rights, and the state in spaces other than Mumbai, and in relation to other urban processes, practices, and infrastructures (Zeiderman, 2013; von Schnitzler, 2016; de Alba, 2017).

However, the claims on urban life that are made through infrastructures are not always expressed or narrated in terms of citizenship but of the politics of survival and participation in infrastructural relations and configurations outside, beyond, or against the state (Meehan, 2014). In said spaces, even people can configure themselves as infrastructures by becoming platforms that allow the provision of urban services and the continuation of urban life (Simone, 2004a). Through practices of convertibility, groups and individuals transform diverse objects, tools, and infrastructures and repurpose them in the making and remaking of socio-material relations. Drawing on these insights, I interrogate how the practices of convertibility and incrementalism (Silver, 2014) that have been shown to be crucial in relation to urban infrastructures in cities of the Global South are part of the everyday performances of state workers in the Lerma System and SACMEX. This interrogation queries how hybridisation takes place through infrastructures, how human labour participates in this process specifically, and how this relates to the making and reproduction of the state and state power. By focusing on state workers, I aim to contribute not only to understandings of

how labour and infrastructure become entangled and unfold, but also to conceptualisations of how the state is made, maintained, and how it is adapted in contexts of socio-material change through workers' practical knowledge.

Whilst the notion of convertibility relates to how infrastructure becomes repurposed to fulfil various functions in allowing diverse flows to take place, enabling city life, it can also be linked to the question of infrastructure as part of the process of metabolisation and circulation of natural resources. This constitutes another main line of enquiry in this dissertation, where I question how labour and infrastructure are part of the making of natural resources, in particular water, and their urbanisation. This interrogation relies on following the socio-ecological relations that are brought together, produced, and transformed by hydraulic infrastructures, and the work of maintenance, repair, and adaptation that is carried out on and through them. In doing so, I not only query how resource making becomes entangled with projects and processes of capitalist urbanisation, modernity, and statecraft (Kaika & Swyngedouw, 2000). I also interrogate how resource and infrastructural materiality might exceed, deviate, challenge, question, and enter other productive tensions with said projects, and how these play out in urban life and space. Here too I show how the role of labour is fundamental, and argue that a careful and profound consideration of how it becomes entangled with infrastructure provides a convincing explanation of how diverse socio-material relations, including those that constitute the urbanisation of nature, are reproduced and stabilised.

HOW THINGS SETTLE: THINKING THROUGH INFRASTRUCTURAL CONFIGURATIONS

Infrastructures are caught in continuous tensions. These certainly include the processes of hybridisation that I have briefly analysed in the previous section, which link together nature,

city, state, materiality, and the various agencies and efficacies of human and non-human bodies, objects, and flows. Another tension is that which is constituted by the precarious stability of the relations infrastructure brings together, and the very materiality through which these relations are produced, reproduced, and furthered. Particular distributions of flows, the institutional arrangements that manage and seek to control them, the very functioning of infrastructures as objects and networks, and the exclusions and inclusions that these enable are being constantly reworked. Following this, I define stability as a continuously achieved status of infrastructural fixity in space, as well as a process through which socio-material relations and flows are made enduring in time, taking hold, and becoming entangled in the making of historical processes. To clarify and analyse each of these dimensions, I use the concept of endurance when referring to temporality, and stability when referring to spatiality and materiality. Through a simultaneous consideration of how infrastructures become stable materially and enduring temporally, and in turn stabilise and make enduring socio-material relations across time and space, it becomes possible to advance a theoretical and analytical stance that is able to query infrastructure as producing and reproducing socio-material worlds both historically and on the everyday.

Throughout this dissertation, I deploy the concept of infrastructural configuration to describe and critically examine these often precariously achieved states of stability and endurance. As mentioned before, I define an infrastructural configuration as a temporal and spatial congealment of particular socio-material relations through infrastructures. These configurations are constituted by flows, and themselves flowing constantly, with congealment being something that is constantly being worked on. These configurations operate throughout the scales of the city, the region, or the nation-state, and those of the body, of a particular infrastructure network or object, and the relations that coalesce around them. Moreover, they bring said scales together, alongside the historical and quotidian

dimensions that constitute them. The task of separating these is an analytical one, as ontologically immanence and historicity are not only entwined but in a process of constant co-determination. An ethnographic approach to infrastructure allows to query how everydayness, quotidian and seemingly mundane practices, the all too common breakdowns, interruptions, and the unevenness of the flows that infrastructures enable are entangled with the continuous making of infrastructural configurations through time. To explore and analyse how these configurations are being constantly achieved implies affirming that the situated, embodied, and particular experiences, practices and processes that circulate through and around infrastructures matter to understand how historicity is made, and how certain patterns of power, inequality, and difference are made, alongside the city, nature, and the state.

In what follows, I introduce and conceptually discuss three of the particular infrastructural configurations that are brought together through the Lerma System hydraulic infrastructures, and that constitute the main topics analysed in this dissertation. Firstly, I argue that an ethnographic approach to infrastructure can be a useful standpoint to interrogate the situated making and reproduction of urban political ecologies (Lawhon, Ernstson, & Silver, 2014). Secondly, I discuss how urban modernity, as a specific configuration, can be analysed through a situated approach, focusing not only on how relations are brought together, but also on how they are in a constant process of decay and breakdown (Gupta, 2018). Thirdly, I address the question of the state in relation to both urban political ecologies and urban modernity. I argue that the state too is an infrastructural configuration, particular insofar its role has been, and continues to be, to institutionalise how the socio-material relations that make up both political ecologies and the projects and processes of capitalist modernity are managed and flow.

URBAN POLITICAL ECOLOGY AS A SET OF SITUATED RELATIONS

Connecting the situatedness of an individual or a resource to broader socio-environmental or political ecological networks has been a topic often explored in critical urban political ecology. From early works in the subject (Harvey D., 1993; Swyngedouw, 1996) to contemporary accounts of how urban resources are made, distributed, and disrupted (von Schnitzler, 2008; Silver, 2015), departing from a situated standpoint in time and space as a site to interrogate the production and unfolding of these socio-material relations is an often used analytical strategy. Recently, the notion of situatedness in relation to urban political ecology has been developed in more theoretical depth and breadth, drawing on from contributions from scholarship that analyses cities in the Global South, in particular in Africa (Lawhon, Ernstson, & Silver, 2014). This approach, being critical of some basic tenets of Marxist theorisations of urban political ecology (Swyngedouw, 2004; Kaika, 2005; Heynen, Kaika, & Swyngedouw, 2006; Loftus, 2012), whilst retaining its concern with inequality, deep-seated injustices, and processes of socio-environmental breakdown, can enter in a productive dialogue with the concept of infrastructural configuration as defined here, and as otherwise developed in current scholarship (Lawhon, Nilsson, Silver, Ernstson, & Lwasa, 2018).

Situated Urban Political Ecology (SUPE), as a theoretical approach, calls for analytical attention to everyday practices in urban contexts, attentive to how social relations are stabilised and made through interactions with infrastructures, producing the city as a place in which often precarious livelihoods can be secured. Instead of starting from the analysis of how the necessity of capital accumulation drives the urban process and shapes urban infrastructures, SUPE theorises power as it is experienced and made in sites in which capital might not fully determine the totality of social relations in urban space. Following this, the concept of power authors working from a SUPE standpoint put forward is one of diffusion

and relationality, being “enacted through a multiplicity of locations and agents.” (Lawhon, Ernstson, & Silver, 2014, p. 509) In this perspective, the possibilities of change stem from and are carried out through situated practices of radical incrementalism, or the ways in which urban dwellers are already producing non-capitalist futures through everyday practices in and through infrastructure. In this dissertation, by focusing on state workers and how they make and maintain hydraulic infrastructures, I shed light not on how alternative futures are being made, but rather on how existing forms of power, nature production and urbanisation, and inequality are produced, reproduced and adapted.

Considering situatedness from workers’ perspectives and practices has a profound impact on how infrastructural configurations are conceptualised here in relation to how they have been researched previously. When considered from the point of view of a user, configurations can “be thought of as the range of infrastructural options potentially available to a person for everyday use, a point which shifts us from focusing on the system-developed-from outside towards situated-users.” (Lawhon, Nilsson, Silver, Ernstson, & Lwasa, 2018, p. 726) This implies analysing infrastructure networks as fluid configurations that might shift depending on the particular position any given user occupies at a specific moment in time and space (see Harvey D., 1993, p. 2). When the focus is placed not on users but on the workers that manage, maintain, and repair hydraulic infrastructures, the definition of infrastructural configuration is expanded to include an analysis of how certain socio-material relations are made stable and enduring through labour. Incrementalism, in this perspective, refers not only to processes of change. By focusing on the interactions between workers, engineers, bureaucrats, and infrastructures, I interrogate how incremental practices that are carried out through infrastructures become crucial in making particular infrastructural configurations stable and durable, including that of the urban political ecology of water supply and distribution. This implies shifting attention both from the system-developed-

from-outside and from situated-users in order to consider how a configuration is made, maintained and adapted from the position of the situated worker.

THE INFRASTRUCTURES OF URBAN MODERNITY

The provision of urbanised resources, and their disposal, is deeply entwined with the project and process of modernity. The urbanisation of water, for example, has been linked to the development of changing ideas of the body, the shifting boundaries between public and private, and the separation of society from nature in a process of abstraction and purification (Latour, 1993; Swyngedouw, 1999). The provision of universal services has been described as a 'modern infrastructural ideal' (Graham & Marvin, 2001), its narratives and material unfolding shaped by the diverging infrastructural configurations of the colonies and the postcolonial world (Gandy, 2014). In Mexico City, the question of infrastructural modernity is entwined with profound differences material and symbolic that make up class and race inequalities both in the contemporary city and in its history (Banister & Widdifield, 2014; Candiani, 2014; Duhau & Girola, 1990; Sánchez-Mejorada, 2005; Vitz, 2018). The provision of modernity through public infrastructures was fundamental to the promises of the Mexican revolution in urban space (Castro, 2004), and its historical and contemporary splintering has been thought of as a challenge to state power (de Alba, 2017). These promises are not particular to Mexico and Mexico City, and indeed the pursuit of modernity has been made through infrastructures in other geographies (Anand, Gupta, & Appel, 2018; Schwenkel, 2018), often with endpoints that are as diverse that they suggest that modernity is not a singular process and project, but one of plurality, difference, and historical and immanent discrepancy.

Modernity then can be defined as a particular infrastructural configuration that entails both the production of abstracted socio-material relations, their reproduction, and the making of numerous projects, processes, imaginaries, and aesthetic registers based on a narrative

premise of universal inclusion and unfolding through multiple exclusions. Across time, modernity has become entangled with the urban process and form, even if it has been argued that this coming together is not innate or necessary, but a historically bounded contingency (Gandy, 2005). It is precisely through this historical coupling that modernity as an infrastructural ideal and configuration can be researched through a situated approach not unlike the one sketched in the previous section. By focusing on how the mediations, materialisations, flows, and abstractions enabled through infrastructures are made and experienced from a particular standpoint, in this case that not of users but of workers, opens up possibilities to analyse and conceptualise how modernity unfolds and becomes congealed. At the same time, focusing on a specific infrastructure network, made precisely at the height of the capitalist modernisation programme of the Mexican post-revolutionary regime (Medina, 1978; Medin, 1990; López-Portillo Tostado, 1995), allows for an exploration of how a particular configuration between city, state, capitalism and modernity becomes stable and enduring. This, crucially, does not imply that there are no other relations challenging this particular vision, project and process of modernity, both historically and contemporarily.

Researching the question of modernity through a situated approach to infrastructural configurations calls for additional strategies to that of focusing on everyday practices. Whilst these remain relevant, as well as narratives of how and why they are carried out in particular ways, means to explore the historicity of infrastructures are called for. Methodologically, this requires attention not only to how socio-material relations unfold in the present but also to how they were planned, projected, and built. As I explore in the following chapter, I carried out such task through both an analysis of workers and bureaucrats narratives of history, time, modernisation and modernity, and through an ethnographic account of archival processes and practices (Stoler, 2009). Theoretically, this implies considering time and history not as

something which contextualises the unfolding of infrastructure and infrastructural configurations but instead as a process made through them, alongside that of space, as hinted at before in this chapter. To conceptualise infrastructures as material history is a theoretical and methodological proposition with at least three main analytical consequences. The first one is that it allows for a situated exploration of history, tracing a particular infrastructural object and network in time through documental and narrative research. The second is that, through this tracing, processes of continuity and possibilities of change become visible, both enabled by everyday practices of infrastructure operation, maintenance, repair and adaption. Finally, the third consequence is that historical becoming is conceptualised as an open-ended, contradictory unfolding, which nevertheless is characterised by the continuous making and remaking of stable and enduring configurations.

The very materiality of infrastructure can become a productive position from which to interrogate how modernity unfolds and is challenged. This is certainly related to the technical operation of hydraulic infrastructures, in the case of the Lerma, but also has an aesthetic dimension (Larkin, 2013; 2018). Infrastructures both enable the experience of certain aesthetic registers in everyday life (Olcese & Savage, 2015), and are also part of the making of modernity as an aesthetic project, where “[u]rban infrastructures are not only material manifestations of political power but they are also systems of representation that lend urban space its cultural meaning.” (Gandy, 2005, p. 39) Through the Lerma System infrastructures, a particular aesthetic project related to the Mexican Revolution, its promises of urban modernity, and their making is put forward, as I will analyse in Chapter 5. At the same time, the material decay and ruination (Gupta, 2018) of these infrastructures of modernity opens up possibilities to study not only how said infrastructural configuration endures but also how it is constantly falling apart and in need of constant work. Infrastructural configurations are also precarious achievements, and the making, remaking, and maintenance of their

paradoxical stabilities can be analysed and conceptualised through a situated, ethnographic approach to labour and infrastructure.

Moreover, the question of how modernity is produced, and unevenly unfolds through the histories of colonialism, capitalism, urbanisation and their entanglements, further advances research of how inequalities are experienced and made. Access to services provided through infrastructures, and constitutive of modernity as process and project, remain highly unequal. In Mexico City, this is visible in the proliferation of non-networked infrastructures of water supply (de Alba, 2017; Schwarz, 2017), a heterogeneous configuration that is indeed present in other urban spaces across the Global South, and has been characterised as an infrastructural archipelago (Allen, Hofmann, Mukherjee, & Walnycki, 2017). This suggests that inequality has indeed a distributional element, related to resource access and the heterogeneity of infrastructure networks and configurations, and at the same time another one related to modernity as a political, technological, moral, and aesthetic project and process. Exclusion and marginalisation therefore relate not only to the question of urban political ecology but, as has been mentioned before, are related to the substantive practices of citizenship and participation in modernity. Related to this question of technopolitical belongings, identities, and practices is that of the making of state in and through infrastructures, which I explore next.

DEFINING THE INFRASTRUCTURAL STATE

The relation between water and state power has been the object of longstanding attention in the social sciences and humanities. It has been argued that forms of institutionalised power that develop through the control of water infrastructures are characterised by rigidly hierarchical organisational features, including specialised bureaucracies and stark class and caste divisions. Foundational studies on the matter discussed the formation of these hydraulic civilisations in contrast to the Western experiences of feudalism and capitalism,

focusing on spaces where what Marx's once termed Oriental Despotism was deemed to be the existing form of economic, social and political organisation (Wittfogel, 1957; Palerm, 2007). More recently, these insights have been developed in relation to the process of historical development of the Western United States (Worster, 1986). In other Marxist accounts, it has also been argued that the state is called upon particularly in the management and production of hydraulic infrastructures, given their scale and coordination requirements, particularly in relation to the subordination of nature as a cheap input for capitalist accumulation and reproduction (Parenti, 2014; Moore, 2015).

Certainly, the question of state power has also been analysed through approaches distinct from Marxist approximations to the matter. In her work on hydraulic infrastructures in Tijuana, Mexico, Katie Meehan (2014) has argued that infrastructure can be conceptualised as tool-power, or as lively objects which are themselves sources of state power and challenges to it. Meehan analyses both networked and non-networked infrastructures and shows how diverse power configurations emerge from each of these ways of producing space and stateness. In this view, centralised, networked infrastructures indeed are productive of state power but, simultaneously, decentralised non-networked infrastructures, such as buckets, hoses, and other situated, incremental infrastructural practices, can be productive of ways of exercising power and making life possible beyond the state. Instead of conceptualising power as stemming from processes abstract and removed from the everyday, Meehan's account calls for an attentive observation of how power is made through infrastructures, and how objects themselves can lead to particular configurations which allow for quotidian acts of resistance and power-making far from the state's gaze.

Hydraulic infrastructures can also lead to conceptualisations of power that focus not on its purported totality, but instead of its constant negotiation, contestation, and its shifting

boundaries. For example, Nikhil Anand's (2011) approach to the question of how urban dwellers exert pressure on the state and its workers and experts has shown that the unfolding of state power through hydraulic infrastructures is not simply impinged upon helpless dwellers, but instead made through interactions in which marginalised groups "make their homes" (p. 544) through diverse material and technopolitical strategies and tactics. This perspective, which analyses the agency of disenfranchised urban dwellers in relation to state power, has been developed in other cities across the world, and in relation to different infrastructures and ways of producing space and socio-material worlds (von Schnitzler, 2008; Zeiderman, 2013). At the same time, the everyday practices of experts, workers, and bureaucrats employed either by the state or by contractors who are building state-led projects, has been shown to be productive of state power through hydraulic infrastructures (Barnes, 2014), and other infrastructure networks, such as roads (Harvey & Knox, 2015).

In this dissertation, I follow this latter set of insights in querying how infrastructures and the numerous labour and expertise practices that are entangled in their management, operation, maintenance, and repair are productive of the state and state power. Whilst I focus on contemporary everyday practices, I read these as being embedded in and bounded by the Lerma infrastructures, an argument that requires an analysis of their history. I do so through the aforementioned methodological strategy of querying archives as process and practice, but also on workers narratives of past labour and expertise. Theoretically, I analyse these questions through the concept of the infrastructural state. As mentioned in the introduction, this concept signals both to how infrastructures are productive of state power, and to how this power unfolds, underpins, and shapes everyday life. Certainly, this does not imply that I theorise state power as total, affirming, for example, that no practices related to hydraulic infrastructures can escape its gaze and control. Instead, I focus on state power's diffusion,

relationality, and porosity. Crucially, I do so by focusing not on how water users challenge or oppose the state and its workers and experts – a topic that has been richly researched in the Mexican context (Cirelli, 1997; Castro, 2004; Perló Cohen & González Reynoso, 2005; Gómez-Fuentes, 2009; de Alba, 2017) – but instead on how the latter’s practices are themselves productive of a form of power that is leaky, patchy, and brittle.

Yet, state power is not easily done away with. Certainly, the particular technopolitical and socio-material challenges that relate to the supply and distribution of water have been productive of a particular state form in Mexico and Mexico City. These are visible in the institutions that seek to control and manage water, even if their grip on infrastructures is highly variable across different moments, sites and processes. Through the Lerma System, the Mexico City government extends its reach far beyond its administrative boundaries, effectively shaping and bringing together regions distant to it through socio-material flows and processes, in what has been recently conceptualised as a *hydropolitan* region (González Reynoso, 2016). Whilst these institutions have endured great change, some of their current practices and objects of governance still resemble those that were made material when the Lerma was built, between 1942 and 1951. Yet, resemblance does not imply sameness, neither in relation to organisational processes, practices, and forms, nor in what concerns the operation and management of particular infrastructures across the Lerma. Instead, the intransigence (Collier, 2011) of the infrastructural state is also being constantly achieved through diverse everyday practices. The endurance of the state as an infrastructural configuration is not seamless. Rather, it is a paradoxical process which unfolds unevenly, yet lastingly, through infrastructures, and the work that is carried out in and through them. Labour, therefore, is crucial to understanding infrastructure and infrastructural configurations, as I will now argue.

THEORISING LABOUR

Labour is what brings together the diverse conceptual positions here developed and constitutes the main focus and contribution of this dissertation. As already mentioned, I define labour as a relational world-making process and practice, unfolding through and with materiality – here that of the Lerma hydraulic infrastructures and the socio-material flows that shape and bounded both labour and infrastructure. Defining labour as simultaneously process and practice underpins the situated approach to the analysis of both history and the everyday that I develop here. This dual focus on process and practice allows querying labour at the moment of its performance, yet keeping in mind its entanglement with the making and maintaining of infrastructure and infrastructural configurations across time. Moreover, a focus on human labour and its particularities sheds light on how these hybrid relations and configurations are adapted through creative and purposeful practices. Whilst these topics have been researched in the context of informal urban living (Simone, 2004b; 2015; Silver, 2014), taking this approach to formal urban workers is a particular contribution made here, which dialogues with current developments in the field (Alda-Vidal, Kooy and Rusca, 2018; Baptista, 2019).

Throughout the text, attention to work practices and labour processes is emphasised, showing how they are fundamental in making and maintaining infrastructures, and essential in making diverse infrastructural configurations stable and enduring. Importantly, this stability is achieved not merely through reproduction of previously existing ways of making and bringing together socio-material relations through hydraulic infrastructures. Rather, adaptation is constantly being worked on in face of numerous changes, both foreseeable and unforeseen, stemming from changes in state policies, socio-environmental processes, and infrastructure breakdown and decay. This approach does not claim that human labour is separate from materiality but rather that, to better understand how hybridity is made,

maintained and remade, both on the everyday and historically, a careful consideration of what is specific about human labour in and through infrastructures is required. Certainly, this also requires considering how matter matters (Bakker & Bridge, 2006), and how it shapes, bounds, and relates to everyday labour practices and to the historical becoming of infrastructure. To do so, I discuss how workers face diverse materialities through their everyday practices and explore how these occurrences are related to processes geographically and historically specific to Mexico City. This implies that the theorisation developed here departs from a situated perspective, although this should not be taken as an affirmation that the logics identified might not be present elsewhere.

In what follows, first I introduce some of the contributions that have been made in the growing field of infrastructure studies. I analyse accounts of repair and maintenance labour. These draw their theoretical insights from a wide range of analytical positions, but they share a commitment to consider thoroughly how materiality and human work interact. Works discussed analyse how repair and maintenance work relates to the making and maintenance not only of infrastructures, but also of diverse forms of power and inequality. Taking into consideration their many contributions, I nevertheless argue that it is possible to develop an analytical approach that, through empirical attention to repair as a distinctive practice, is able to explain not only how labour and infrastructure become intertwined, but also how they are entangled in the making, maintenance, and adaptation of hybrid relations both historically and on the everyday. I then analyse different Marxist approaches to this question, linking them to discussions on hybridity and infrastructure. I argue that a concept of labour that is attentive to its performances as practices and process, and that both acknowledges hybridity and the specificity of human work, can become a powerful tool in better understanding how infrastructures, and the relations they bring together, endure and adapt, and in advancing a synthesis of historical and new materialist approaches to these questions.

RESEARCHING INFRASTRUCTURE REPAIR AND MAINTENANCE

The role of human labour has been drawing increasing attention in the analysis of infrastructures, in particular through the research of repair and maintenance practices. These are conceptualised as necessary for the functioning of infrastructures. Far from being stable objects, which perform their labour without need for upkeep, infrastructures need to be taken care of (Denis & Pontille, 2015). In this process, the agency of human labour is central, as infrastructures “require human communities to maintain them, even as they shape those (and other) communities. Without maintenance, infrastructures crack, rust, and crumble and the political projects, promises, and aspirations that they carried dissipate” (Carse, 2014, p. 219). Graham and Thrift (2007) have argued that these material practices “keep modern societies going” (p. 1). It is through them that “the constant decay of the world is held off” (p. 1). This maintenance work is commonly referred to as invisible (Star, 1999), as a pre-emptive repair process that keeps infrastructure together and working (Strebel, 2011). Often, the task that scholars researching this topic set out to do is to make visible work that otherwise would not be noticed, and yet is crucial in stabilising both particular spaces and wider assemblages and orders. However, this is not always the case, as repair and maintenance can become very much visible amidst widespread infrastructural decay (Graham & Thrift, 2007; Anand, 2015)

In that way, maintenance work can bring numerous spaces into being, sustaining their functions and their everyday operation. For example, through maintenance work, the Red Road housing estate in Glasgow is precariously kept living, even when facing demolition (Strebel, 2011). Repair and maintenance are also central in the case of the Paris subway, analysed by Denis and Pontille (2015). There, the continuous making of a stable reality is achieved by human workers and their labour practices. Specifically, they do so through the maintenance of signposts, which are themselves producers of a material ordering. Denis and

Pontille's analysis of this work points to the constitutive role maintenance plays in the making of the worlds we inhabit, which they frame as a "care practice" (p. 355) that repair workers do on and through fragile things. This is not a mechanical process but rather one shaped by and shaping constantly institutional, environmental, political, economic, and social practices, processes, and flows through infrastructures. Human labour also enables the continued entanglement of said flows and processes in the making and remaking of hybrid worlds. Repair and maintenance, and the lack of them (Chu, 2014), are socio-material and technopolitical practices fundamental to the making of infrastructures and infrastructural configurations.

This is certainly the case in urban spaces. Graham and Thrift (2007) have emphasised that the precarious stability of urban life is the result of "swarming masses of repair workers tinkering with the prosaic technicalities" (2007, p. 9) that constitute it. Anand (2015) has shown that maintenance work is productive of socio-material configurations that put in question the boundaries between legality and illegality, formality and informality, and other binaries that are normally deployed when talking about urban spaces. Analysing the measurement and repair of leaks, he argues that engineers, through their labour, are part of the making of leaks not as lacks or excesses, but rather as an integral part of the technopolitics of urban life. Focusing on repair and maintenance shows that the ecological, social, spatial, and political orders that are made through infrastructures are not self-replicating. Instead, they are being constantly shaped by workers' creativity, ingenuity, embodied expertise (Björkman, 2015; 2018) and practical knowledge. This improvisational work is not a deviation from a standard, but rather the rule in the maintenance of infrastructures, at least in the case of the Lerma System. This is what here I conceptualise as *patchwork* (Chapter 6), following workers' and engineers' descriptions of their own labour.

The repair and maintenance of infrastructures can also be crucial in reproducing sets of institutionalised relations. In her analysis of these practices in the case of irrigation infrastructures in Egypt, Jessica Barnes brings the reproductive functions of human repair and maintenance to the fore (2017). There, she frames the maintenance process as a work of “profound social, economic, and political significance.” (p. 147). Through maintenance, not only the infrastructure network is kept up, but also “relations of state power and community are produced in and through a water infrastructure” (p. 149). Through their action, the state’s experts and employees in charge of the irrigation channels, and the communities that use them, and maintain them, are part of the reproduction of the state as a set of political, social, and material relations. This is a concept of the state that sees it “not as a monolith that stands above and separate, but as a multifaceted entity whose authority is produced through everyday bureaucratic practices” (p. 149), of which water management is but one.

In this dissertation, I follow these contributions by critically interrogating the role of labour in maintaining and repairing infrastructures. To do so, I distinguish between repair and maintenance as two different practices, an analytical stance that has not been explored thoroughly in recent literature (but see Jackson, 2014, for an example of the opposite). In fact, repair and maintenance often appear as always already operating together. This leads to considering forms of anticipatory work, such as pre-emptively maintaining hydraulic infrastructures (Barnes, 2017) or protecting infrastructures against theft (Baptista, 2019), and the practices that are part of the everyday operation of infrastructures (Alda-Vidal, Kooy & Rusca, 2018; Anand 2011; 2015; 2017), with those that follow breakdown. In this dissertation I analyse these forms of labour separately. This is an analytical distinction that is not translated neatly onto the field, where boundaries between forms of work are blurry and constantly shifting. Yet, I claim that separating them here enables me to query what is

specific about human labour, and to conceptualise and theorise this specificity through the situated analysis of diverse forms of work and the ways in which they relate to infrastructure.

Following from the distinction between maintenance and repair practice, I suggest that the forms of human labour that sustain the Lerma System can be analysed as instances of two different logics: maintenance and adaptation. Maintenance implies those practices that seek to act before breakdown, either in an effort to delay the moment of its occurrence, or to sustain a fragile normality in face of the inevitable moment of breakdown. Here I analyse these practices on Chapters 4, 5 and 7, analysing archiving, management and operation work. This logic of maintenance pertains not only the material infrastructures that are being worked on, or the forms of power and difference that are enabled through them. It also comprises the maintenance of workers' identities, collective narratives and shared memories of labour and infrastructure. Chapter 6, and to a lesser degree chapters 5 and 7, deal with questions of repair and adaptation. Analysing workers' practices of incrementality, convertibility and improvisation is also a distinctive contribution of this dissertation, as it empirically analyses a space that is comparatively understudied: the formal provision of urban services from the standpoint of the workers that sustain it through their everyday labour. In doing so, I contribute to the aforementioned analyses of maintenance and infrastructure, whilst exploring the distinctiveness of repair labour. Finally, this conceptualisation of labour calls for particular attention into how the question of matter comes to matter (Bakker & Bridge, 2006), and how it relates to other relational accounts.

LABOUR AS A WORLD-MAKING ACTIVITY

This centrality of human labour has been highlighted by authors working in Marxist approaches to the infrastructural question, and through critiques of new materialist standpoints and conceptualisations. Namely, labour has been framed as the practice that is behind the making of hybrid urban spaces (Kaika & Swyngedouw, 2000), and as constituting

the very materiality of infrastructure as dead labour (Kirsch & Mitchell, 2004). More recently, a renewed focus on human labour has been proposed as a way to politicise new materialisms, and to shed light on the class conflicts that exist in the processes of producing hybrid worlds (Arboleda, 2017). This certainly resonates with authors who, analysing infrastructures, highlight the role of labour in maintaining them, but is a broader argument regarding the ways in which human labour practices reproduce capitalist socio-material relations and configurations, amidst other historical processes. This specificity of labour can be traced back to Marx's early works. In the 1844 Political and Philosophical Manuscripts, he affirms that "the worker can create nothing without *nature*, without the *sensuous external world*. It is the material on which his labour is realised, in which it is active, from which and by means of which it produces." (Marx & Engels, 1959, p. 273)

This relation between human being and nature, as one of transformation and metabolisation through labour, underpins Marxist approaches to the analysis of capital and capitalism. How capital fetishizes these relations as they unfold through infrastructure has been previously explored (Kaika & Swyngedouw, 2000), showing that in the process of producing urban nature, the products of labour are estranged from the workers who made them. As I will show throughout this dissertation, there are certainly numerous moments when SACMEX workers reflect on the many injustices that characterise their working life, and the broader inequalities in which they are embedded and unwillingly help to maintain adapt. However, this is not the main focus of this dissertation, as it seeks to explore work as process and practice from a situated perspective. This approach, which holds together these two aspects of labour, can be linked to Marx's early accounts, where labour is defined as a world-making practice and process that is always being developed through relations with socio-material processes, objects, and flows, particularly those that constitute that which has been historically defined as nature.

What nature is and how to account for it is then crucial for this definition. As I have mentioned in this chapter and in the introduction, current research on questions of infrastructure has highlighted the hybridity of socio-material relations and doing away with the notion of nature as an entity distinct of society, focusing instead on how these and other objects are made together through relational processes that unfold historically and on the everyday. However, an affirmation of hybridity and of the mutual constitution of society and nature, and indeed of other binaries, does not mean that materiality is unimportant. Quite the opposite. How infrastructures, and the material spaces in which they are embedded, are materially made matters for how labour operates and for how workers learn and use certain forms of practical knowledge and embodied expertise. This is particularly the case when departing from a situated perspective, where the everyday relations between infrastructure, matter and workers are the object of analysis and the site of theorisation. This means that the geographically and historically specific materialities of infrastructure and soil, water, rust and austerity in Mexico City must be considered when developing a hybrid conceptualisation of labour.

In this dissertation, I conceptualise labour precisely as this world-making, relational practice and process, shaped and bound by other lively socio-material processes, which it in turn produces, maintains and adapts. In highlighting the creative, adaptive and improvisational facets of labour I do not deny that in the production of commodities, and even in the making of natural resources, it is often the case that the products of labour and infrastructure are separated from workers, who often live in conditions of marginalisation and inequality. I also do not affirm that workers are able to supersede the embeddedness of infrastructure in the making of socio-material processes. Certainly, the historical unfolding of infrastructure networks, of resource-making and urban practices and processes, and of the institutional practices and forms that seek to control and manage these infrastructural configurations are

all part of the shaping of contemporary labour practices. Workers do not freely determine the outcomes of their labour, as the task of supplying water to Mexico City, and the many entrenched inequalities and marginalisations that are entwined with these flows, are constantly being reproduced and remade as they carry out their work.

Workers are aware of this, and of the demands made through infrastructural form and flow. However, they are also conscious of the relevance that their particular improvisational and creative skills and practices have, and of the role that their practical knowledge has in the making, maintenance, and repair of infrastructure and infrastructural configurations. This is particularly salient when they face the unruly materialities of Mexico City, its water, infrastructure and subsoil. There, their work is not reduced to a mere cog in a fully automated machine, and virtuosity is not estranged from workers who very much continue to understand their labour and that of others through the deployment of particular skills, situated knowledges, and emergent practices when making and remaking socio-material worlds through infrastructure. I argue that it is this precisely this performance of labour as a through practices of ingeniousness, purposefulness, and constant tinkering that which allows infrastructure to endure, maintaining and adapting numerous socio-material processes, both through the emergent patterns and practices of the everyday, and in their sedimentation and historical unfolding, precarious and patchy as it proves to be when analysed from a situated, ethnographic perspective. By querying the role of labour in and through infrastructure, insights regarding its relationality, its constant transformations and adaptations, and the making of paradoxical and contradictory continuities in face of continuous material change can be gained. In turn, these can be deployed to explain how the Lerma System has become entangled with the production, reproduction, and adaptation of infrastructural configurations in Mexico City both historically and on the everyday.

Finally, this conception of labour, which brings together its practical and processual dimensions – without denying the importance of keeping them separate when elaborating more abstract accounts of critical political economy and political ecology - can become a productive standpoint to interrogate questions of historicity and becoming. By developing a situated approach to the making, maintaining and adaptation of hybrid relations, flows, and configurations, their unfolding appears not as stemming from historical necessities or prefigured endpoints. Instead, emphasis is placed on the oppositional socio-material relations between endurance and stability and brittleness and patchiness. There, the maintenance of particular configurations, such as the ones that characterise the making of urban water in Mexico City, and of their many environmental, distributional and institutional inequalities is not a given but rather the continuously achieved outcome of human labour in and through infrastructure. Crucially, this maintenance is not a repetition of previously existing relations but rather a process of constant adaptation, enabled by human workers' creative and ingenious labour and its relational making through the Lerma, yet always framed by institutionalised and materially embedded inequalities, power relations and ways of doing and thinking labour and its possibilities. By considering human labour's specificities and particularities in the making of hybrid relations and spaces, this dissertation develops an analytical and theoretical proposal that might be relevant beyond the Mexico City waterworks.

3. STUDYING LABOUR AND INFRASTRUCTURE: METHODOLOGICAL APPROACH

INTRODUCTION

On August 2016, I arrived in Mexico City to conduct the year-long ethnographic fieldwork that this dissertation is built on. It was a strange return to the city I was born in, and where I have spent most of my life. I was travelling back there not to research the city as a whole, or to focus on a particular neighbourhood. Instead, my goal was to explore how the Lerma System worked, and the role it might play in the conjoint making of nature, city, and power across time and space. My outlook was, and still is, heavily influenced by numerous ethnographic works that take infrastructure as their research object (Carse, 2012; Björkman, 2015; Harvey & Knox, 2015; von Schnitzler, 2016; Anand, 2017). I was also carrying with me numerous readings on water, capitalism, and modernity (Gandy, 2002; 2014; Swyngedouw, 2004; 2015), and was concerned with the question of hybridity and human and non-human agencies (Latour, 2005; Bennett, 2010). Concepts, processes, debates, and cities far across the world occupied my mind. I was in Mexico City but not yet thinking with and through the infrastructures that I was there to analyse. I still had to make that city that I professed to know so well strange, and to see its water infrastructures as if I had not been taking them for granted for most of my life.

The path I followed when carrying out an ethnography of the Lerma water supply system, and of SACMEX, the public utility that manages it, escaped my concerns and planning efforts. The turns, detours, and shortcuts I took did not lend themselves to foresight. The research space I constructed through the Lerma was not an even one, in which strict rules are followed, but instead one in which conditions changed rapidly, and tactics and strategies were constantly adapting. Not being defined by clear boundaries but instead constituted by

networked infrastructures and all the materials, individuals, groups, processes and relations they bring together, the task of tracing and following that characterises ethnographic work often departed in lines of flight (Deleuze & Guattari, 2004) that linked territories, maps, forms of power, cities, natures, and pasts, presents, and potential futures in shifting ways. Facing such a proliferating research space, in which the complexity and interrelatedness of infrastructure as a hybrid, socio-material process, the most pressing methodological task was how to keep feet and mind close to the ground. In practice, this implied making decisions regarding how tracing would be carried out, and who or what would be followed in search for description and explanation.

Beforehand, I had envisioned a quite literal version of this tracing, in which following the pipes would show the connections between nature, city, and power, and would allow me to see how infrastructures might be a part of these relations. My intuition was that nothing should be left out in advance. I could not set clear boundaries beforehand, and instead had to look at how networked infrastructures were constituted, and how diverse materials, individuals, groups, processes, and relations were brought together through them. Where the tracing would stop was not something I had decided, even if this concern had rarely escaped my mind. This research space was spiralling out of control, and was only brought down to earth when I managed to carry out the first interviews. My questions were naïve. I wanted to understand something – the Lerma System and its place in the broader Mexico City water grid – that I did not grasp at all. I kept asking questions about everyday operation, convinced that there would be where an explanation to how hybridity is made through infrastructures would be found. My interlocutors were senior engineers, concerned not with that but with budgetary problems, political strife, and the rapid depletion of water resources in Mexico City. I found their answers insufficient, and I believe they found my questions strange.

However, these early interviews also started showing me a path to research the Lerma ethnographically, and to understand how the work it does is sustained through common practices. Senior engineers pointed me towards workers, engineers and bureaucrats under their supervision that were deeply involved on the everyday operation of the grid. These starting interviews also allowed me to see that my hypothesis that the Lerma was relevant insofar it was a crucial part of the production of urban modernity in Mexico City was not completely off the mark. Engineers often pondered on the relevance of that particular infrastructural system, and on the importance of the networked grid in general. They worried about the future of water in Mexico City, and were often openly upset about the decreasing budgets that SACMEX had been facing for decades then. Through these conversations, I started exploring how the Lerma was a particular thread in the complex, layered fabric that constitutes the Mexico City water network. By virtue of being under control of SACMEX, even when located in the neighbouring state of Mexico, the Lerma infrastructures began challenging what I knew about the governance of urban water in Mexico City, and of the makeup of the Mexican state. Later on, these interviews would also allow me to think of the many gaps, blank spaces, and willing and unwilling stances of ignorance that characterise water infrastructure, management, and repair.

This chapter develops the methodological approach I followed during my fieldwork. It also analyses how research design and literature reviews influenced my practical decisions in the field, and it explains the analytical strategy I followed once I gathered ethnographic material through participant observation. The chapter starts by introducing a paramount question: how can infrastructures be researched ethnographically? I proceed by showing how I answered this question in practice, through the diverse strategies, tactics, and practices of access, mapping, working, and tracing that I carried out during my fieldwork. Following this discussion, I present how I approached the archives I analysed for this dissertation, and how

the decision of carrying out archival research relates to the fieldwork carried out with workers and engineers. After analysing these topics, I discuss how my own class positionality influenced my research in practice, and how it shaped many of my relations with workers and engineers, as well as my own approach to the labour they carried out. Things that remain unknown to my research participants and I are telling of what the limits of tracing infrastructures ethnographically might be. I discuss these gaps, silences and missing links in detail, looking to understand how they have shaped this work. Finally, I discuss my analytical strategy, highlighting the interactions between the field and theory.

HOW DO YOU RESEARCH INFRASTRUCTURES ETHNOGRAPHICALLY?

This dissertation began with an intuition. It was not one that came out of nowhere but was heavily influenced by readings on the city, capitalism, modernity, and water. Namely, I thought that it would be possible to take a specific hydraulic infrastructure and trace all the relations that it brought together, all the individuals and groups that had a hand in its production, and all those involved in its maintenance or decay, as a way to reconstitute a political ecological history of Mexico City (see Swyngedouw, 1999, for a similar insight concerning a glass of water). The fact that this had been once the city on a lake (Vitz, 2018), and that much of its histories dealt with how water had always been at the centre of urban life and process shaped this way of thinking. Importantly, by focusing on infrastructure as something that links past with present, this exploration would also concern itself with thinking hydraulic infrastructures as a material palimpsest, in which history does not follow progressive and discrete temporalities but instead conflicting, multiple ones that coalesce and coexist, shaping not only current practices but also ways of imagining the future. I would argue still that this task is possible, although its completion would require a much more expansive, intensive, and longer fieldwork period than the one available for this dissertation.



FIGURE 4. MONUMENTAL HYDRAULIC INFRASTRUCTURES: THE RIVER LERMA WATER DEPOSIT

Crucially, these insights came not only from scholarly research; the monumentality of some hydraulic infrastructures in Mexico City also informed this way of thinking, a topic I explore in Chapter 5 of this dissertation. Functioning pumps; decaying measurement stations; water deposits turned into museums, and enormous drains and aqueducts hidden from view, deep in the underground – all of them could be windows into the complex political ecologies of water in Mexico City, past and present. One of them drove much of my thinking: The River Lerma Water Deposit (Figure 4), and the mural and sculptures that Diego Rivera painted there. Whilst I discuss these in detail in the aforementioned chapter, it is relevant to consider now some of its material characteristics. The Deposit was once the endpoint of the Lerma System, and its waters covered the mural as a way to make what is depicted come alive. Amidst the many figures, processes, and promises painted there, I wish to highlight one now. To both sides of the tunnel through which water entered, four workers distribute water to diverse members of the Mexico City population (Figure 5). These workers in action suggested

that the Lerma was not a self-sustaining infrastructure but rather one in need of constant labour.



FIGURE 5. WATER PROVISION AND THE ROLE OF LABOUR

Work practices and processes are the one of the main focuses of this dissertation. They are a way to research infrastructures ethnographically. Following workers, engineers, bureaucrats, urban dwellers, and other groups and individuals as they work in and through infrastructures is a key methodological approach I followed throughout my dissertation. Their ways of seeing, doing, and thinking are not only questions to be analysed critically but also practices to which I relate and through which I build my own thinking and analytical strategies. Therefore, work is not only a set of practices, a process, and a relation to be analysed. It is also a way of thinking, conceptualising, and doing research. Exploring how and why different groups of workers do what they do is relevant to understand how the Lerma System works, and how it has changed across time. Besides that, working alongside these

different groups also informed how I think about infrastructures, and how I develop the arguments presented in this dissertation. In that way, labour is a method of ethnographic research, insofar that it involves a full participation on behalf of the researcher, as I will explain further ahead in this chapter.

ACCESS

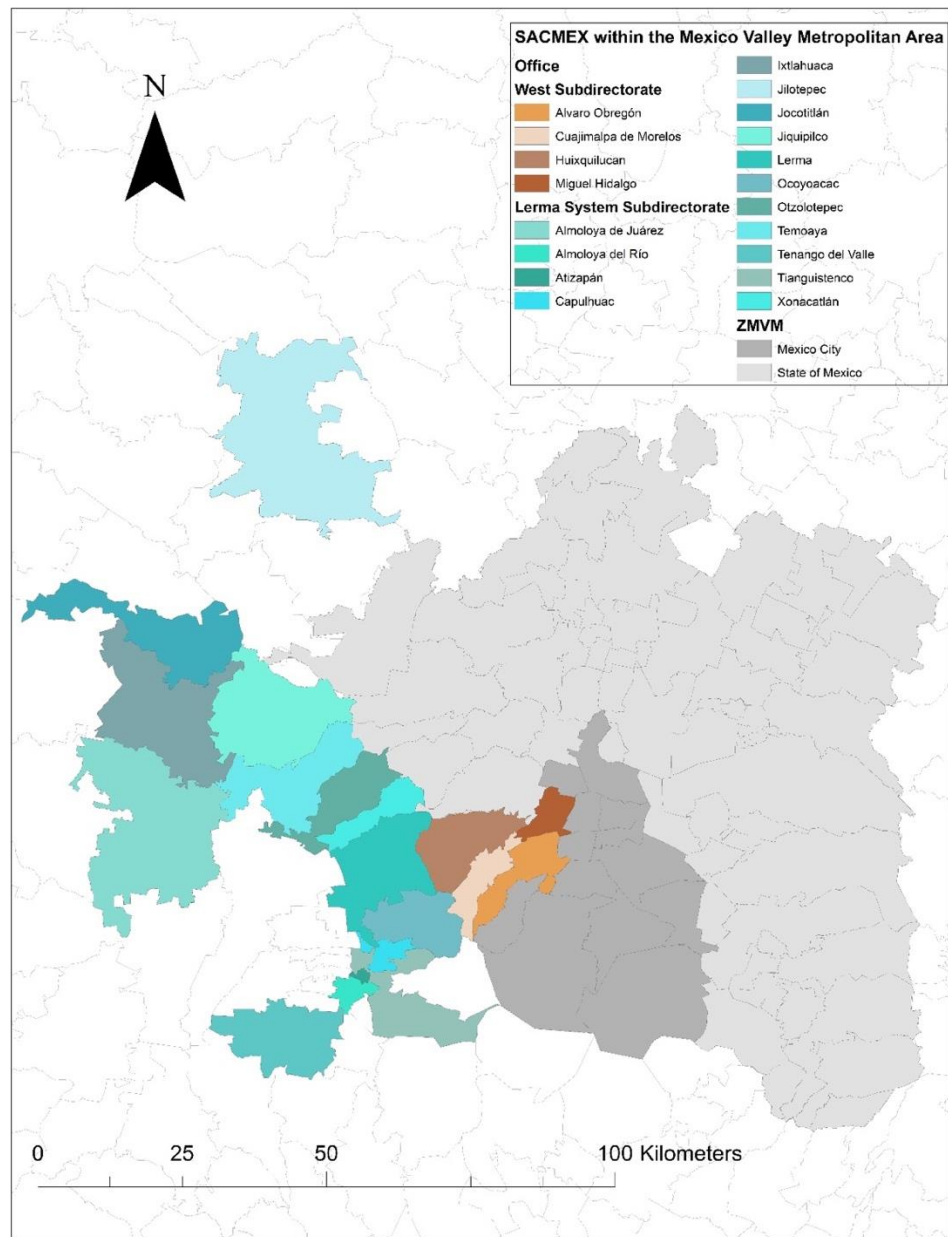
I gathered a series of contacts, emails, and telephone numbers from my discussions with senior engineers. Eager to understand the everyday operation of the Lerma System in particular, and SACMEX at large, they directed me to those who had more contact with pipes, aqueducts, pumps, workers, and the field. My first contact with these senior officials had been similar: sending emails, making phone calls, organising meetings, requesting interviews, and getting mostly affirmative and cooperative answers. Access was therefore straightforward – even surprisingly so. No one seemed too interested in why I wanted to research workers and mid and low-level engineers and their practices. Senior engineers explained that indeed it was there where the operation of the water grid was ensured but they also affirmed in no uncertain terms that it was the bureaucratic, political, and policy work they carried out that mattered. I suggest that my desire to research the space of the everyday, messy, dirty, often invisible and unseen was not perceived as a potential problem for them. This already positions the work of management, operation, maintenance, and repair as the underbelly of how this infrastructural system works.

Once I contacted the mid-level engineers that the senior ones suggested, the path towards the work teams that carry out most of the manual labour, and to the bureaucrats involved in the quotidian management of the grid was almost without obstacles or drawbacks. This process implied a few meetings that were driving me towards a different destination. Over the course of time, the Lerma System has become intertwined with other supply systems, in particular the Cutzamala one, managed by the Federal Government up to the point of water

distribution. After this point, the Lerma waters mix with the Cutzamala ones, as well as with others extracted from the aquifer in Mexico City, and captured in the many springs in its mountains, once forested and now increasingly urbanised. Delimitation of where the Lerma ends and where something else begins is not entirely clear, yet it remains relevant not only for this research but also for SACMEX's operation and monitoring, as I will show in chapter 7. In methodological terms, this implied deciding which threads not to pursue, following both the ways workers and engineers defined the Lerma, and how I framed it through background research.

The only setback I encountered happened in early September. After one month of accompanying workers in Lerma as they showed me different infrastructures there. Once I requested to not only be shown around but actually seeing how work was carried out, a mid-level engineer in that office requested signed documents from the central SACMEX office. I went back, requested a meeting with the Director for Potable Water, and he asked to see an official headed letter from my institution. I managed to get the document in a week, and then spent three weeks visiting the central offices at different days of the week, whilst I continued to carry out work in other locations. The reason I was given was that this work was potentially dangerous, and, not being a worker, I would not be covered by any insurance. SACMEX was making sure that I understood the risks, and that they would not be held responsible if something happened to me. This demarcation between the low-risk job of bureaucracy, and the potentially perilous one of repair, maintenance, and operation, suggests that this work is not only largely invisible and marginal but also dangerous. This is a risk fewer and fewer are willing to take.

MAPPING THE FIELD



MAP 2. MAPPING THE FIELD SITES: SACMEX OFFICES, MUNICIPALITIES AND BOROUGH³

During my fieldwork, I was based at two different SACMEX Sub-Directorates: Lerma and Poniente (Map 2). These offices deal with the everyday operation of the water supply grid,

³ Map by the author and J. Eduardo Ibarra-Olivo.

as well as with repair and maintenance tasks. They are part of the Directorate for Water and Potabilization, which in turn is located under the General Directorate for Potable Water in SACMEX's organisational chart (Figure 6). These Sub-Directorates were normally called Offices, and were led by *ingenieros* (engineers) García, in Lerma, and Obregón, in Poniente. I met them first, and through them got in touch with the engineers and workers that were out in the field every day. My interactions with these two sub-directors were not limited to that, as I often ran into them when carrying out research, sometimes in their offices, and others in the field. The many conversations we had and their insights about how SACMEX works are an integral part of the empirical data presented in this dissertation. Obregón was much more involved in the quotidian tasks of repair, maintenance, and operation, whilst García spent more time in his office, or dealing with local politicians and community leaders. These personality traits and work practices shape the kind of knowledge I built with them, and the type of information they provided.

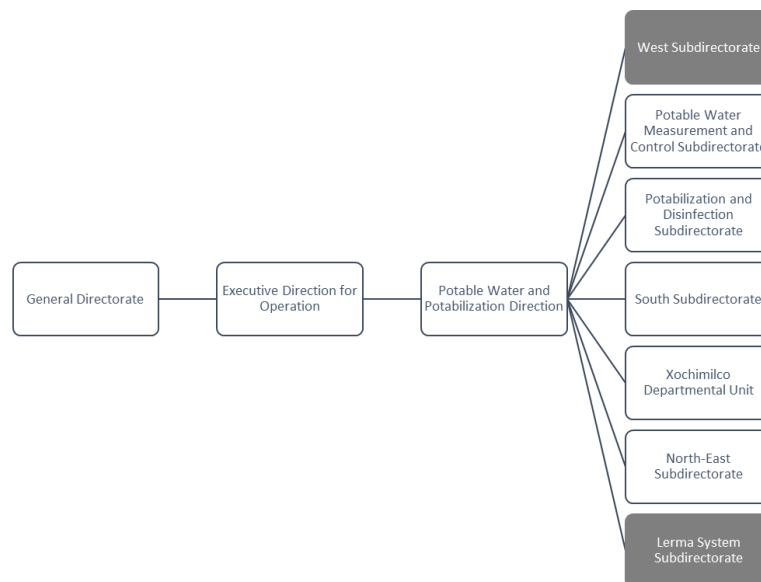


FIGURE 6. LOCATING THE FIELD SITES WITHIN SACMEX ORGANISATIONAL CHART

My work in Lerma and Poniente was different, both as a reflection of the particular tasks that predominated in each site, but also as a result of the different relations I was able to build

with workers, bureaucrats, and engineers. In Lerma, most of my data comes from the work I carried out with one of the two repair and maintenance teams in the area. This particular team was led by Pablo, who was often absent, and in his place the task of leading the team fell unto the second on command, Artemio. I was instructed to work with them by *Ingeniero* Hernán, who was the head of the repair and maintenance unit there. I accompanied and worked with them for 10 months out of the 12 I spent in SACMEX, at least once a week but often two times, and rarely more than that. The other two months I spent with Moctezuma, a bureaucrat in the area, close to engineer García, and self-styled head of the local archive. He showed me most of the Lerma System, highlighting the infrastructures he considered crucial for its operation, or relevant insofar they would allow me to understand how the System works and operates.

In Poniente, my everyday tasks were different. I was there at least twice a week during the 12 months of fieldwork, excepting short periods in which I was outside Mexico City. There I was mostly following engineer Maza, the head of the repair and maintenance teams. At the beginning he was keen on showing me the main infrastructures in his area. However, as we I became a regular presence in Poniente, he became less concerned with this, and instead had me accompanying him to survey infrastructures, discuss repair and maintenance tasks with other engineers both from SACMEX, other governmental dependencies, and private companies that had a stake on the many infrastructures that exist below the ground in Mexico City. These interactions, and the long trips we took when monitoring infrastructures and workers, allowed me to understand the vastness of hydraulic infrastructures in Mexico City. I was also able to observe how they are an integral part of how urban inequalities are made and experienced. Finally, being part of numerous failed attempts at finding leaks, or solving operational problems in different infrastructures, allowed me to see how they often escape governmental control and management.

I also accompanied two different work teams in Poniente on several occasions during that year. My work with them often was limited to travelling across Mexico City, both responding to complaints made by citizens, or to urgent tasks given to them by their bosses. I spent decidedly less time with these teams than with Pablo's and Artemio's one in Lerma but still I got sufficient time and data to be able to observe commonalities and discrepancies between their labour and the infrastructures through which they work. Finally, I worked with other bureaucrats carrying out different tasks. I helped Miguel, the head of the radio during a month or so, and simultaneously aided Santiago, Poniente's draughtsman. I also was part of the drafting of a monthly report, even if I witnessed how others were made before that one. The tasks I carried out in Poniente broadened the scope of this dissertation, providing much data regarding the relations between bureaucratic labour, infrastructures, and the state, beyond the work of repair and maintenance.

WORKING HAND IN HAND

On my first day in the repair and maintenance office in Lerma, *Ingeniero* Hernán drove me to the workshop where the work teams assembled every morning before being given work orders from him. He told me that he had been working for SACMEX in Mexico City for a couple of years before being transferred to Lerma, 5 years ago. At the beginning, he said, it had been difficult for him to gain the workers' respect. He thought they considered him just another city engineer, stopping for a few months or years on his way to a better position far from Lerma. In order to gain their trust and respect, he told me, he had to work hand in hand with them. It was not sufficient to merely give orders or watch from afar. He had to get his hands dirty, understanding how workers went about solving issues, fixing pipes, and maintaining infrastructures by doing as they did. He ended this anecdote by telling me I had to do the same if I wanted to be trusted and respected. I could not expect to just observe, I had to participate; fieldwork rules were quickly established, and I had little say in that.

That first day showed how unprepared I was for the tasks at hand. I had the wrong shoes, was wearing a shirt that was way too uncomfortable for working hours under the sun, and my attachment to my little notebook was hindering my ability to help. I decided this had to change, and I bought some cheap boots, wore old t-shirts beneath my shirt, and left my notebook aside, making voice notes on my mobile phone, and writing longer reflections on the long journeys from Lerma to Mexico City, which take at least 3 hours. Still, I was not working hand in hand, as Hernán had suggested. I felt apprehensive. I did not know what to do and was somewhat afraid of being looked down by the workers. This reluctance did not help my cause. Some workers asked probing questions, concerned that I might have been there sent by someone higher up in the organisational chart to spy on them – a concern workers in Poniente shared too. I realised, perhaps later than what I would have liked, that the only way was to work as Hernán advised. Admitting my limited plumbing and mechanical skills, I normally limited myself to carrying pipes, wrenches, and other tools.

I tried to work as hard as I could, and this did not go unacknowledged. Soon workers started joking around, giving me a nickname, and sharing more and more stories about the many problems they faced when doing their job. I also improved in the few more hands-on tasks I helped with beyond carrying things around. When the task was, for example, unscrewing or screwing to large pipe sections, I took turns with the other workers to push and pull the large wrenches we needed to do this. My ability to work in tandem, reading my fellow workers' movements and rhythms increased. I still remember fondly when Artemio told Pablo that 'I wasn't that bad at it anymore'. I felt incredibly proud and worked even harder the next time around. Through labour I built stronger relationships with my colleagues, and began to be part of the team, even if always painfully different, and there only for a limited time. I never fully became an insider, and we all knew this. Yet, I was also no longer seen as a spy – something that also happened in Poniente, even if there it took me more time.

I want to suggest that this experience is relevant beyond questions of access, trust, comradery, and respect. Being that work is a purposeful practice through which individuals and groups transform the material world in which they live, and with which they relate in myriad ways, I suggest that doing work is a methodological strategy in itself. It was by performing the same tasks that workers did that I managed to gain a better understanding of the particularities of their labour. Through labour I was able to gain a deeper insight into the intricacies and complexities that characterise the work of repair and maintenance. As I adopted this approach in my work with bureaucrats, I also learned the basics of how to monitor water levels and flows; how to calculate these quantities, expressing them in different measuring units; and how to produce the reports that inform much of SACMEX's task of infrastructure management and operation. By working hand in hand with them too, I was able to explore how these work practices relate to questions of state, nature, and urban production and reproduction.

This methodological approach informs my conceptualisation of labour. Labour is a world-making relation with others, whether they are human workers sweating side by side, distant engineers giving orders that sometimes do not match what is encountered in the field, or unruly materials, such as water, steel, and plastic, and the many ways in which they break down, flow unexpectedly, or escape control and oversight. The relationality of labour, which brings together the body, nature, state institutions, the city, and different social groups, is both an empirical theme and a way in which I conducted research for this dissertation. It is one that puts hybridity at the centre of my enquiry, whilst allowing me to understand how humans and non-humans relate, and their different and changing roles. By not only observing or documenting the ways in which workers relate to infrastructures, but carrying out that work myself, I was able to gain insights into how human labour might differ from

other agencies, insofar it is purposeful, creative, and therefore central to understanding how and why certain infrastructural configurations change, endure, or fall apart.

TRACING

Workers, bureaucrats, and engineers guided me through the sprawling, complex Mexico City water grid. They showed me those sites which they considered relevant, both in terms of their place in the formal layout of the network, and in relation to their own experiences working at SACMEX. Instead of following the uncountable lines that depart from each infrastructure, linking them to the materials that they are made of, the flows of capital that financed them, the diverse water bodies that they are constantly transforming, and the other infrastructures they are connected with, I traced alongside these hybrid relations from the point of view of these workers⁴. Methodologically, this is what constitutes the situated approach to labour and infrastructure that this dissertation takes. It means following how workers engage with the everyday materialities of infrastructure, from breakdown and operation to the archives and offices where knowledge of the grid is made stable and enduring.

This tracing also reveals the porous boundaries of the Lerma System and its entwinement with other hydraulic infrastructures in Mexico City. Ever since its construction, and certainly as the grid has expanded since then, the Lerma has been connected to infrastructures built in different times and connecting diverse spaces. Indeed, hydraulic infrastructures in Mexico City can be thought of as a palimpsest of materialised temporalities, in which projects

⁴ This is a situated approach that draws both from the Situated Urban Political Ecology perspective (Lawhon, Ernstson, & Silver, 2014), as well as from some of the ethnographic tenets of Actor-Network Theory (Latour, 2005). However, it differs from the latter insofar it does not presuppose a symmetry between human and non-human agencies, instead taking this question as an empirical one. In doing so, this methodological approach contributes to critiques of Actor-Network Theory (Castree, 2002; Kirsch & Mitchell, 2004; Gareau, 2005; Moore, 2015), as well as to debates on assemblage urbanisms and its potential limits and shortcomings (McFarlane, 2011; Brenner, Madden, & Wachsmuth, 2011).

designed and executed in diverse political economic and political ecological configurations where built. Infrastructures cement these relations and bring them together in ways often contradictory. 19th Century promises of modernity become entwined with the pursuit of capitalist development in the 20th Century, and with changing practices and ideas of nature, state, city, and citizen. However, even in this messiness and multiplicity, there are distinctive elements that allow a tracing of the Lerma to take place. The fact that the Lerma System is still managed by the Mexico City government, even when it sprawls into other states, is one of them. The Lerma is not limitless; its contours are identifiable, even if they are constantly being crossed by wanted and unwanted flows, objects, and bodies.

The process of pinpointing these limits and understanding what they mean in researching the role of infrastructures in the production of power, nature, and city across time and space, was also carried out following workers' insights, practices, and narratives. Therefore, I do not define in advance where the Lerma System starts and ends in relation to contemporary water flows, work practices, and governance processes. These fluctuating limits are discussed through workers, engineers, and bureaucrats' perspectives, narratives, and practices. This is the reason why often the discussion veers away from the Lerma and into SACMEX at large; these shifts are indicative of the intertwinement of the Lerma with the broader water infrastructures in Mexico City. Notwithstanding this fluidity, there are indeed many instances in which the Lerma is stabilised. These include practices of statistical calculation, report drafting, and responsibility allocation. Crucially, the Lerma is also researchable as a defined infrastructural system in the many archives that hold files on water and Mexico City, and in the task of archiving as process (Stoler, 2002; 2009), as carried out both formally and informally by workers at SACMEX and in other institutions within the local and the federal governments.

NAVIGATING THE ARCHIVES

I had considered carrying out archival work to understand how the Lerma had been planned and designed from the onset. I was interested in researching both the technical aspects of the project and the legal and political discussions that might have surrounded. This decision was made following work that shows that technology and politics, or technopolitics, always develop in tandem (Mitchell, 2002; Barnes, 2014; von Schnitzler, 2016). I thought of the archive as a complementary site to the everyday practices of infrastructure management, operation, repair, and maintenance. However, after a few months in the field, this other site slipped out of view. I became too immersed in the everyday workings of the Lerma and SACMEX, and the goal of understanding the history of the Lerma Project was put on hold. Never completely forgotten, it was simply transformed into something that I would do at some other time. The archive remained a site in which the past was held, and not as a process and set of practices participating in the making of the present.

This changed not as part of a deliberate strategy but as a result of the workers own labour of tracing the Lerma. It was their own practices of archiving what brought this question back into the centre of my enquiry. The archive was a central part of how they understood the Lerma, its history, and their roles in it today and in the past. When asking them questions about how the grid worked, what the history of the Lerma was and how it operated in the present, and how their work had changed over the years, workers often showed me files, reports, manuals, and other documents they had in their offices. These files were not ordered, nor kept as part of a process of archiving as the construction of a public memory and a means of state control over infrastructure, nature, and the past. Instead, as I will argue in the following chapter, they were kept as a material memory of previous labour, and as a claim on its past and present value. These informal archiving practices ranged from single

copies of old manuals or institutional reports, to more thorough efforts to concentrate large quantities of documents, awaiting a future in which they could be classified properly.

My interest renewed, I decided to begin my search of relevant archival material. I began by conducting online searches in databases, but I rapidly realised these would not be useful. Often, information regarding the contents of each file box was not detailed enough to be able to tell where relevant materials might be kept. Some search engines did not work well online, and some, like the ones from the Mexico City Historical Archive (AHCDMX) simply did not exist. After reviewing existing literature on the topic, I decided that the Historical Water Archive (AHA), managed by the National Water Commission (CONAGUA), would be a good starting point. As time went by, I would carry out research in the AHCDMX, in the General Archive of the Nation (AGN), and in the archive at the National Centre for Plastic Arts Research, Documentation, and Information (CENIDIAP), as well as in libraries at the National Autonomous University (UNAM), and in the Iberian-American University. Why and how I traced the Lerma to these archives will be explored in the following section.

FOLLOW THE LEADS

If this archival path started in distant, unremarkable offices in Poniente and Lerma, it quickly led me to better established institutions. As I have mentioned the AHA was the first of them. Upon arrival, Elsa, the archivist, told me that I was in the wrong place. The Lerma System and Project files, she said, should not be held there. The AHA was a federal archive, she explained, and the Lerma was a state-level project. If there were to be found anywhere, she said, it would be in the AHCDMX. Still, she was willing to help me do a quick search. She helped me to a computer and guided me through the different catalogues that could be accessed there. The whole AHA collection has been digitally indexed, allowing us to quickly gain an idea of how many Lerma-related files were there. The number was staggering; there were 17,920 registers available. The first two visits consisted on refining the search, selecting a few

documents that looked promising and making rough notes on them. I began by searching within the years in which the Lerma was built, 1941 to 1952, expanding the search from 1938 to 1955. This still showed too many results. It was only until I limited the search to one documental collection, the one related to National Waters, that I found information specific to the project, and not to other water-related issues in Lerma.

Elsa was surprised I had found these documents. She was almost certain there would be nothing specific to the Lerma System and Project, given that it had been always a Mexico City issue. That these files were held at the AHA is relevant to understand how the planning, construction, and management of this infrastructure is part of the making of the Mexican state, its institutional dynamics, and the boundaries between federal and state competencies, both materially and legally. The Project files, which I analyse thoroughly in the following chapter, were held in two different boxes: 232 and 348. The other files dealing with the Lerma area had to do with local requests to use water from specific springs, and with previous attempts to desiccate the lagoons in order to create new arable land. In contrast, boxes 232 and 348 contained information related to the technical design of the Lerma, and to the bureaucratic process it followed in order to be approved and built. However, information stopped there. Files that dealt with the actual construction process, and with posterior management and operation questions were no longer held at the AHA. As I will explain in the following chapter, this is a result of the making of the Lerma waters as a Mexico City issue, instead of a federal one.

The path then took me to the AHCDMX, where I found a situation very different from the one at the AHA. The AHA is a relatively small archive, specialised in water questions on the federal level. The AHCDMX, in contrast, deals with numerous issues that span from the colonial period to contemporary times, including certainly water works, but also legislative questions, minutes concerning the exercise of executive power, and many other topics. The

sheer dimension of the AHCDMX is compounded by a lack of thorough cataloguing. Upon arriving to the administrative office on my first day there, I told the worker in charge of granting access and helping users navigate the catalogue that I was interested in the Lerma Project and System. He looked at me with a look that anticipated trouble, and that I have not forgotten since. He explained that it might be difficult for me to find specific information on the Project, as the documents concerning hydraulic infrastructures were part of a broader collection on public works from 1929 until 1997 that was yet to be fully ordered.

Instead of having the Lerma archives, or indeed water-related ones, organised by topic, date, or project, I found them mixed up with others related to roads, electricity, and even the construction of monuments in the city. The only guide was a word or two in the description of each box: *'Agua – Lerma'* or *'Proyecto Lerma'*. Still, I tried to find relevant information during the six months I spent in the archive – which became much more intensive in the last three I spent in Mexico City. This was a painstaking, slow task. The rudimentary catalogue helped me identify some promising files in around a dozen boxes. Unfortunately, information was extremely scarce. I found some copies of payrolls from the 1940s; a contract concerning the measurement and design of filtration galleries in Lerma, from 1941, and some plans that included the Lerma but did not contain any more information about it. Archivists there asked me to make notes for them, detailing files I reviewed, in an effort to advance the cataloguing process. The haphazard way in which this task was carried out led me to think that there must be thousands of documents I could not review. Missed by previous cataloguing efforts, searching them would have implied going through each one of the thousands of boxes related to public works in the period mentioned before, something that far exceeded my possibilities at the time.

The AHCDMX was mostly a dead end, even if the silences and missing links that I found there are relevant, as I will discuss in the following section. The AGN provided relevant information

in relation to how the Lerma figured in the annual reports that presidents give to the Congress, a practice akin to the United States Presidency State of the Union. The CENIDIAP provided information regarding the Lerma River Water Deposit, in particular from the perspective of Diego Rivera, as his personal files are archived there. I consulted academic journals, magazines, and other documents from the period at the libraries at the National Autonomous University (UNAM) and the Iberian-American University. These texts were central in researching how the Lerma was being discussed by experts at the time, how nature was being conceptualised in relation to the city, the state, progress, modernity, and capitalism. These archives and libraries, and the files and documents that I was able to track down and analyse, provided data that informs many arguments regarding the historical role of the Lerma and its transformations and continuities. At the same time, they shed light on the question of archiving as practice and process, embedded in broader infrastructural configurations.

EMBEDDED ARCHIVES

Archives are entangled in the rich tapestry of relations that constitute and are constituted through infrastructures. The files that they hold are traces that can be picked up and followed both within the archive and beyond. Not only do documents, plans, and the many notes made on their margins allowed me to follow the Lerma across different boxes, archives, and sites. At the same time, they pointed at processes and practices that I had been observing in the everyday operation of the Lerma System. A key example is the fact that the many agreements that I could trace down in the archive were recurrently mentioned by workers, water users, engineers, and bureaucrats. The archive is not simply a place in which files are kept but a site that can be conjured if needed to make claims or explain and justify actions taken today. Files and archives make up infrastructure not only in a previously existing moment of planning but throughout their present functioning. They are an integral part of

the ethnographic approach that guides this dissertation. I consider them precisely as sites that are embedded in the present and not as the source of a definitive version of the past. The relation between the contemporary and the historical is not one that necessarily follows a linear temporality, often shaped by transecting lines that cross through the archive and into everyday infrastructural practices and processes.

Moreover, archives themselves can be thought of as infrastructures, shaped by the relations formed through diverse materialities, supported and enabled by different work practices and processes, and subjected too to decay and ruination. Archives in the Lerma System, and in SACMEX, are not homogenous, as the particular agencies and materials that come together to produce them differ greatly. They are operated and maintained unequally, depending on their funding, their archiving practices, the size of their collections, their institutional embeddedness, and their relation to researchers, water users, and other governmental dependencies. Some archives can indeed be conceptualised as sites in which state power is made through extensive documentation of diverse practices, processes, groups, individuals, infrastructures, and their characteristics, makeup, and changes. Others, however, participate differently in the constitution of power, infrastructure, and nature both in history and today. Informal, self-managed archives are embedded in relations that, whilst not exclusive to the formation and maintenance of state power, are not responding to top-down directives or thoroughly planned designs. Instead, they show how the relations between state, labour, nature, and infrastructure are too present in everyday practices and processes, and therefore can be researched there.

The embeddedness of archives then operates in at least two different registers. The first one concerns the aforementioned socio-material relations of which they are a part, shaping and being shaped by them simultaneously. These traverse and bring together local relations, others operating at the level of the high offices of state, political contentions between and

amongst workers, water users, groups disconnected from the grid, bureaucrats, experts and politicians, as well as rain patterns, depleting aquifers, and changing ways of knowing and representing water and nature. Tracing these relationships allows for an exploration of how water, infrastructure and labour relate to the production of nature, city, and state in the Lerma System. The second register refers to a spatial-temporal embeddedness, or to the endurance of certain infrastructural configurations that are also researchable through archives. This certainly concerns the question of what is contained in files as information or data. Yet, it includes far more than this. It also encompasses a consideration of why certain archives have come to hold certain files, why some might be located elsewhere, why some have ended up being precariously guarded by workers, and why some indeed constitute the present-shaping memory of state power and its production. Considering archives as actualising and materialising past projects, becoming related to present practices of archiving, infrastructure operation, repair, and maintenance, and enabling certain ways of doing and knowing to endure in the future is a perspective that informs and is developed throughout this dissertation.

Finally, I suggest that researching archives as part of broader ethnographic methodological strategies can be a way to deepen accounts of infrastructure. Here I have done so not by engaging with the archive as a site that reveals the truth of the past, but rather as a place in which diverse connections to present infrastructures are visible. By tracing these relations, I substantiate the claim that it is possible to analyse infrastructures as material history. In order to do so, I think of historical processes, such as state formation or nature production, not as ordered around discrete temporalities marked by clear beginnings and endings. Rather, I frame them as being in a process of continuous and unresolved unfolding, which is visible in the files held in the archives, in the way the archives are run and were designed, and in the relations that workers themselves find between files, archives, infrastructures and

their labour. By following workers' leads, moreover, I fully embed this archival work in the wider ethnographic project, even if archives frequently exceeded these insights, and the Lerma project itself.

RUMOURS, SILENCES, GAPS, AND MISSING LINKS

Ethnographic tracing and research are constrained by numerous processes and conditions. Certainly, these include ones related to my possibilities as a researcher. Time, budget, practical considerations such as distances to travel, and many other questions, both foreseeable and not, are some of them. Others can be considered almost intrinsic to the ethnographic craft. Research participants' narratives, practices, and memories are always shaped by their own positionality, ideological outlook, and by the decisions they make when interacting with a researcher. Even if I became closer to workers, engineers, and bureaucrats as fieldwork went on, assuming that deceptions, omissions, forgetfulness, or misrepresentation play no part in these subjects' narratives or recollections would imply assuming an unmediated access to socio-material relations that is possible neither in practice nor in theory. Still, some other gaps, silences, and missing links can be productive in terms of research, signalling at specific sites, relations, or processes that perhaps are being deliberately kept out of sight. In what follows, I explore three of these blind spots: the question of how money flowed in the construction of the Lerma System; the issue of corruption in present-day Mexico City, and the question of memory, both related to my own research and to workers' practices and narratives. I argue that each of one of these indicates some productive limits of carrying out ethnographic research on labour and infrastructures.

WHEN MONEY LEAVES NO TRACE

In all the haphazardness that characterised my experience of carrying out research in the AHCDMX, a recurrent pattern stood out: almost all references to finance, money, or how the

Lerma budget was used were nowhere to be found. These absences sometimes seemed deliberate. An otherwise thorough file would be missing just those pages that might have contained some information regarding how money was spent, who was paid, and how much. It is known that the Lerma costed \$225,607,737 pesos of the time, equivalent to \$5,065 million pesos in 2008 (Rosales García, 2015, p. 74), or £321,581,192 pounds sterling today, considering inflation rates. Most of this money was allocated directly from Mexico City's budget, except for 19%, which was funded through a Federal loan⁵. Where it flowed, and who actually built the different infrastructures that constitute the Lerma materially, and how much did they cost was not something I was able to research during my fieldwork. Given how these absences appeared to be systematic and purposeful, at least in what concerns this research, I suggest that they constitute a deliberate effort to keep hidden how these specific practices worked, and how they link the state to capital, and to specific capitalists in post-revolutionary Mexico.

However, the fact that money could not be traced in the Lerma files does not mean that the relations between capital and state remain completely occult. The state is certainly produced through infrastructures, as they bring together processes of nature appropriation, resource making and distribution, and urbanisation, and through the labour practices that enable and reproduce these processes and relations. At the same time, these state infrastructures underpin the processes of capitalist accumulation through those very tasks of appropriation, provision, construction, and distribution. However, the very fact that the documents that might have shown how these works were assigned, carried out, and by whom have been seemingly erased or destroyed in purpose suggests a particularity. Namely, that in the formation not of capital as a process both economic and ecological, but of capitalists as a

⁵ See p. 74

social group, the infrastructural state is also crucial. This much is shown by research, which indicates that under the patronage of the PRI, and in particular during Miguel Alemán's administration, numerous companies that grew to become conglomerates were made, precisely through their role in building infrastructure (López-Portillo Tostado, 1995). How the Lerma System might be part of these relations remains a topic to be researched in disentangling the relations between state and capital in modern Mexico.

UBIQUITOUS CORRUPTION

Analogous to the missing pages that might tell the story of how certain companies, individuals, and groups became part of the construction of the Lerma are the contemporary imagined, yet silenced, links between state and capitalists. Many of the conversations I had with workers, engineers, and bureaucrats pointed to the ubiquity of corruption. When driving around the upscale neighbourhood of Santa Fé, for example, a common discussion topic concerned the illegal takes that allegedly connect luxury high-rises to the water grid. Some workers even put a price tag on these illegal connections: up to \$2,000,000 Mexican pesos, or around £83,000 pounds sterling. Other SACMEX employees did not produce figures but supported the idea that these connections were far too common in Mexico City, being accounted then as leaks. Other recurrent question was that of private water tankers (*pipas*). Whilst the Mexico City government provides this service in certain neighbourhoods in the city (De Alba, 2017), private providers proliferate. Many of my research subjects openly discussed how this water was taken illegally from SACMEX facilities, whether with or without the participation of supervisors and senior officers. In many different shapes, corruption was something that preoccupied SACMEX personnel, even if I never did witness any instance of such.

Again, the mere fact that these relations were being brought up constantly points out to something productive about the unseen links between corruption, state, infrastructure, and

urbanisation in contemporary Mexico City. Corruption here appears as more than a deviation from a norm of how state administration should be carried out. Whilst undoubtedly workers and engineers often framed their narratives on the topic as a matter of morality, the practices that they alluded to exceed this dimension, having a clear technopolitical role. Corruption seems to be a way of producing space, which certainly included hydraulic infrastructures but also extends to housing, roads, energy, and other urban infrastructures in contemporary Mexico. In this process of production, corruption could be seen as becoming something fundamental to the exercise and production of state power. Simultaneously, corruption would play a key role in the reproduction of capital in urban space, not only through the materialisation of certain financial flows but also through the production of the infrastructures that support urban life and urbanisation. These missing links can be explored through an ethnographic approach like the one developed here, even if the particularity of the topic might imply that speculation will always be a part of such an enquiry.

A MEMORY OF INFRASTRUCTURE

Much of this dissertation deals with workers' memories and recollections about the Lerma System and SACMEX at large. I see memory as a way to reconstruct the relations between infrastructure, labour, nature, and state, which reveals something often unseen, not unlike the discussions around corruption. This reconstruction is always also construction, insofar as memories are not faithful imprints of the past but rather narratives told from the viewpoint of the present. At the same time, these memories allow workers, engineers, and bureaucrats to bridge the gaps between the formal knowledge of the grid, contained in maps, plans, reports, and manuals, and the informal one, which includes the changes and omissions often present in the former, and also becomes a means to amend errors in the aforementioned representational tools. Here too the fact that something is missing from normative ideas of how the grid should work, and how the institutions that seek to manage it ought to function,

is productive of a critical perspective on infrastructure. Throughout this dissertation, I develop the question of memory in much more detail than the two briefly discussed before, as it is fundamental to how workers relate to infrastructure, and to how the socio-material relations that are brought together through it are produced and made lasting.

There is, however, a second way in which memory and recollections work in this dissertation. I refer to the task of writing fieldnotes, and to the challenges that the particular kind of fieldwork I carried out posed. As I got more and more involved in the everyday workings of infrastructure management, repair, and maintenance, chances to take notes from a comfortable distance rapidly decreased. My notebook became a hindrance to labour, and I often had to leave it in my backpack, either inside a truck or in a locker in one of the workshops I frequented. Unable to document things as they were happening, I had to trust my memory and the devices that make it material and enduring. Habitually I would walk away from the site where we were working to record a short message on my mobile phone that I would later listen to and expand into a more exhaustive field note. Jottings and scribbles were also usual, and they would later become the basis of expanded notes.

As time went by, my fieldwork notebook also became a dense layering of thorough notes, almost unintelligible jottings, conceptual diagrams, poorly drawn maps, disorganised reflections, and everyday concerns. Depending on how tired I was, I would try to consolidate an extensive note online after coming back from the field, or at most the morning after. Using the notes made in the field, or closer to the moment in which I was there, I tried to reconstruct a narrative of what had happened, striving to capture workers' ways of telling – but also of doing. Some of the notes are brimming with details, and others betray just how exhausted I often was after long journeys that could take up to six hours working, and six hours in public transportation a day. When in doubt, I could always look at my notebook, until I could no more. One evening, late into my fieldwork period, my backpack was stolen

from under my feet at a cinema. I looked for it to no avail. I grudgingly resigned myself to this new situation. Many long-forgotten clues, quotations, descriptions, and reflections are now in someone's home, or even in the garbage. My memories are bridging the gaps between what I observed and what is registered through the digital infrastructures that I used to make these ethnographic observations enduring.

SEGÚN EL SAPO ES LA PEDRADA: LABOUR, CLASS, AND POSITIONALITY

Before being stolen and lost, my notebook also played a different part during fieldwork. At the beginning, before I started following Hernán's advice of working hand in hand to the letter, I often distanced myself through this research tool. Standing next to the workers, pen in hand and notebook open, I tried to gather as much information as I could. Workers often looked at me suspiciously but refrained to say anything. After around five weeks of being in the field, *Gallo*, one of the workers at a repair and management crew, looked at me and angrily asked me if I thought they were animals. I was taken aback by this question and said I most definitely did not. He then pointed at the notebook, letting me know in no uncertain terms that this practice was being perceived, at least by some, as a disrespectful and distancing practice. I told him I was sorry, that I only wanted to understand what they did, and that I was just making notes for myself. He said it was alright, but that if I really did want to understand what they did, I had to either really observe, or do it myself.

This conversation took place two weeks before I met *ingeniero* Hernán. That day, besides telling me that hard work was crucial, he mentioned something else that was indicative of my own position in the field. He noted how my boots were not suited for the kind of work they did there. They were too fragile, and I needed to get a decent pair that could endure water, dirt, mud, and the heavy lifting he expected me to do. He said that the workers there got a pair a year but that their boots normally lasted longer than that. That meant that they

had spare pairs, which they might have been willing to sell to me. I asked him how much he thought they would cost. He looked at me and laughed in advance of his answer. '*Según el sapo es la pedrada*', he said. This is a popular saying, meaning that they would set a price according to how they would perceive me in terms of class. If they thought I had money, they would be quite expensive. By the way Hernán looked at me, and through some very basic reflection, I knew the price would be indeed quite high. I laughed back and said that I might have a look back home. I ended up buying a pair in a street stall next to a big construction site for £10 the week after. Not a bad offer.

These vignettes illustrate how the question of class is constitutive of the research process. It was evident that my class positionality was different from that of the workers, perhaps closer to some of the engineers, but still quite distant in different ways. Take, for example, the diverging educational trajectories of engineers and myself. Whilst many of them studied at UNAM, like me during my undergraduate, few continued their studies, and none that I met had studied outside of Mexico or to a PhD level. Class-related differences were also visible in relation to aesthetic questions, such as clothing, footwear, haircuts, and accessories – taste and distinction – and also in terms of embodied behaviours. Ways of speaking, cultural references, sense of humour, educational and work trajectories, and many other ways of doing and carrying oneself were also at play. These differences are indicative not only of the class dynamics at play in this research field but in contemporary Mexico City and its hinterlands today. Inequality, difference, oppression, and violence are at high and were still increasing, and my experience in carrying out ethnographic research are not exempt from this situation. I do not claim that I managed to overcome these differences through my practice. Class is not something wished away or overcome by individual actions alone. However, I can say that throughout this work I strive to make my position clear, and to speak not for the workers, engineers, and bureaucrats, but with them. I also look to show how,

despite their marginalisation, they are fundamental to the tasks of water urbanisation and statecraft in contemporary Mexico.

THEY CALLED ME SCHOOLBOY

As I became a frequent face in the field and started working despite all my limitations and clumsiness, workers attitudes towards me started to change. I brought food to share, a fundamental part of every morning with the repair and maintenance teams across SACMEX. I often stayed after work to have a beer or two, or even had some during work hours if the day was slow and the weather was warm. I became more confident and started joking around too. I offered to buy things from Mexico City for the Lerma crews, and told many stories of London, in particular of the pubs, which I identified as a cause of my ability to keep up with their drinking habits. The initial wariness slowly ebbed, being replaced by a sense of belonging that, even if never complete, made me a curious part of the teams, always with one foot back in London and a PhD. The notebook, once a source of anger and mistrust, became a point of mockery. A particularly jovial worker, *Morrito* (literally 'Little Kid', called like that due to his high-pitched voice and short height) christened me as *Escolar*. A nickname that, when pronounced, sounds almost like the English word 'scholar' but actually means 'schoolboy'. Schoolboy I was, constantly being asked when my homework was due. 'In three years or so', I responded, and they laughed, perhaps taking it as a joke and not as a task I am completing now as I type these words.

BEING LOOKED DOWN UPON IN THE TUBE

As I became more and more involved in everyday work, and the workers' attitudes started to switch, other things changed too. I would get back home through different means. A trip to Lerma or Poniente implied taking one or two buses back to downtown Mexico City – a journey that could take between one and a half and three hours – and then the underground,

or a bike, if I was feeling energetic or unwilling to deal with crowded trains. After being carrying pipes and wrenches around, walking in muddy water, and sweating profusely, I was dirty, smelly, and visibly bearing the marks of labour. I became more and more curious of how others might perceive me, as sometimes in the field I would be taken as one of team, whilst others my demeanour, and perhaps even my skin colour, set me apart from my companions. In the tube, without others to be compared to, I often encountered disdainful looks, people changing seats, or clutching their possessions. I cannot claim this means that I abandoned my own positionality, but I argue that this suggests that the experience of being a manual worker is laden with others' value judgements about oneself, which structure everyday life in profound ways.

LEAVING THE FIELD

I wish I could say that my leaving from the field was a planned, informed moment, in which I got a moment to thank all of the workers for teaching me how to work and how to think about labour and infrastructure. Whilst I tried actively to be thankful and show my appreciation for all the conversations and generosity with which they welcomed me as time went on, there was not a specific event in which I gave some sort of announcement about my return to London. Towards the end of my field, I started spending a lot more time in the archives, as I realised I needed much more information regarding the Lerma Project, and that I would not have the chance to do so if I kept going to Lerma and Poniente recurrently. I tried to go back to Lerma once to say goodbye, but no one was there, as the workers had been given the day off by *ingeniero* Hernán. I only found one of the workers, who was waiting for a mechanic to come help him with his motorcycle, which had broken down. I told him to pass my best to the other guys, and I am certain he did so. In Poniente, I phoned *ingeniero* Maza before I left, and he wished me well. I keep in touch with some of them through email, even

if their responses have become less and less prompt. I left the field not with a big farewell but in silence.

ANALYTICAL STRATEGY

BETWEEN THEORY AND EMPIRICAL RESEARCH PRACTICE

The decision to study the Lerma System departed from a theoretically informed position. Following the works summarised in the previous chapter, I was interested in understanding how infrastructure relates to resource making, urbanisation, and the making of the state. I had envisioned departing from two entry points: the Lerma River Water Deposit, and the site where a new dam for the Cutzamala System was being planned, in San Pedro Tenayac, state of Mexico. I was interested in understanding the contentions around resource making, and to analyse how water became entangled with urbanisation and state making. In order to do so, I sought to carry out ethnographic research, exploring how workers, engineers, urban dwellers, and groups and individuals challenging state policies and politics conceptualised water and its potential uses and relations with other socio-material processes and with infrastructure. In that regard, the topics of the state and state power, nature urbanisation and capitalism, and infrastructure as a hybridising process and object were clear from the onset. I was interested in these two sites, as I expected them to be gateways to research the transformations that these processes and their intertwinements had undergone in two different historical moments: the aftermath of the Mexican Revolution, and the contemporary neoliberal moment. Theory, then, played a prominent part in defining the research objectives for this dissertation.

Everything changed right after I arrived in Mexico City. My efforts to contact CONAGUA officers, and through them gain access to the dam site in San Pedro, had been unsuccessful until then – and would ultimately remain so. At the same time, the traces of what the Lerma

System was and is still today started proliferating. Soon I realised a project focused on the Lerma would be already substantive, and that expanding such an enquiry to two interbasin transfers might not be feasible in practice. At the same time, I noticed how I had focused too much on narratives and conceptualisations of water, and not enough on how infrastructure was managed, maintained, repaired, and archived. My focus did not leave out said narratives but expanded to include the question of practice. Both are crucial in understanding how infrastructures are made, how they bring together numerous socio-material processes, and how they make them endure in relational infrastructural configurations. Crucially, this focus on practice became centred on one specific group: public workers, engineers, and bureaucrats. This implied that research would interrogate in much more detail how the state worked within, and how state workers relate to groups beyond the state. In that way, the state became a much more central topic, querying more thoroughly its relation to resource making and urbanisation.

The relation between theory and empirical research practice therefore switched. If at the start it was theory what drove this research project, the field demanded a partial inversion of this relation. This certainly does not mean that the theoretical outlook was abandoned. Indeed, my readings of infrastructures elsewhere, both in the Global North and South, in urban and rural spaces, and across history and contemporarily, kept informing my views and practices. The relation between theory and practice unfolded throughout my fieldwork and is present in the fieldnotes themselves. They show me constantly referring to readings and thinking how certain processes and practices I was observing related, reinforced or questioned previous findings on this area of scholarly enquiry. If anything, these back and forth narratives decreased as I became more and more embedded in the field site. As time went on, description became even denser, although I deliberately wrote aiming for a thick description (Geertz, 1973, pp. 3-30) of each site and situation, accounting not only for

human-human interactions but also those with and amongst non-humans. As I better understood what was at stake, my gaze became better suited to inform a profound reading of each situation on its own terms, giving way to ways of conceptualising that were in dialogue with workers' perspectives and practices.

IDENTIFYING THEMES

Themes started emerging soon after my fieldwork fully started, in August 2016. By December of that year, questions of state making and urbanisation had been displaced by the relevance of labour, in particular that of repair and maintenance. I was certainly thinking of infrastructures as processes, constantly changing, before I arrived in Mexico City. However, I had not fully considered the role of state workers in making infrastructures stable and enduring, and allowing for the constant making and reproduction of myriad socio-material relations. As part of my fieldwork, I wrote an analytical brief, which summarised findings and attempted to link back themes to my original project. Whilst I was certain that the questions of the state, nature, and the city were at play, now the task was to conceptualise how these related to labour, and in particular to that of repair and maintenance. This was the first analytical task I undertook, even if it is presented only in the second half of the dissertation. As a certain German philosopher and political economist stated, the order of exposition does not necessarily follow the order of enquiry (Marx, 2004). In this case, even if labour was both the focus of my early empirical research and theorisation, it is the role of the archive and the materiality of infrastructure what takes precedence in the order in which findings are presented.

Upon my return to London, in August 2017, I began the slow process of systematically reviewing my fieldnotes. I started chronologically, even if I had already put in place a very rough coding system. These early codes were introduced as I transcribed fieldnotes from my notebook to a computer. They were developed in an iterative process, in which later findings

led to reconsidering previous codification, and introduced new topics. Some of these early codes show how I was concerned from the start with both humans and non-humans, and the ways in which they become entwined and relate to each other in the field. They are relational codes, which seek to highlight certain practices, processes, or situations. Some of these relate to workers' practices, behaviours, or ways of doing, like 'creativity', 'improvisation', or 'maintenance'. Others look to describe the materiality of infrastructure, and the relevance of material objects and processes in the Lerma System. Examples of these early codes are 'automatization', 'leakage', or 'quantitative data'. Others are already pointing out at the relation between materiality and historical processes and projects, highlighting how infrastructures are part of a discourse and practice of modernity, the nation, and their aesthetic representations. Without being exhaustive, I want to mention that indeed others began the task of identifying how power, inequality, and hierarchies were being made, remade, and challenged, both within work teams, and between state workers and water users.

These codes, and others that emerged during the first phase of data analysis, led to brief analytical notes, akin to the one I drafted in Mexico City on repair and maintenance. I started conceptualising how work was intertwined with the processes of maintaining resource making, distributing water unequally, and through these and other processes, was part of the reproduction of the Mexican state and of its role in providing water for the continuous urbanisation of Mexico City. At the same time, I undertook an analytical process of the data contained in the documents reviewed in the archives in Mexico City. Using pictures I took of complete files, in particular those held at the AHA, I began a process of coding each document, tracing several topics. Amongst them, the questions of science, technology, and knowledge in relation to nature; capitalism, development, progress, modernity, and the state, and infrastructure, expertise and bureaucracy are of paramount relevance. As these

documents were digitalised as pictures, software analysis proved impossible, and I carried out this task by reviewing each photograph and consolidating information on a large database.

Through these reviews, the simple codes developed started becoming concepts. These concepts guide each of the empirical chapters. The first one, Chapter 4, focuses on archiving as process and practice. The distinctions made between formal and self-managed archives, and the arguments regarding the role of these in relation to state, labour, and nature, follow not only literature on the topic, but mainly workers' practices and narratives. Chapter 5 develops the concept of infrastructural aesthetics. It is here where the theoretical drive is particularly clear, allowing me to analyse the materiality of infrastructure, and its relation to modernity, state, and capital. It is here where the material tracing of infrastructures as they operate today is developed more fully. Chapters 6 and 7 look in detail into workers' practices and narratives. There, I focus on how their work is characterised by practical knowledge and how this relates to the processes and practices of resource making, urbanisation, and statecraft. To explore them, I rely on concepts that emerge from workers' narratives and descriptions of their own labour. The main concept developed is that of *patchwork*, which comes from the notion that workers have that their practices are mainly done of patching an infrastructural grid and configuration that is always falling apart. This task of patching, or repairing, maintaining, and adapting infrastructures, is what constitutes one of the main linkages between the historical processes analysed in particular on Chapter 4, and the contemporary and quotidian relations between labour and infrastructure.

INFRASTRUCTURE AND LABOUR AS METHODOLOGY IN PRACTICE

The relations between infrastructure and labour are manifold. They bring together distant sites, materially and symbolically, and they become constitutive of historical processes, bridging the past with the present in ways often contested and multiple. Researching how

these relations unfold points certainly to the relational constitution of the worlds we inhabit. In the case of the Lerma, on virtue of being a state-owned and managed infrastructure, built in the heyday of the Mexican post-revolutionary regime, and of its pursue of capitalist development, the topics that emerge shed light on how nature, state, city, infrastructure, and labour develop in tandem through time and space. By analysing not only the Lerma System's planning, design, and construction history, but also present practices of management, operation, archiving, maintenance, and repair, I explore how these temporalities become entwined, and how history proceeds through paradoxes and contradictions that participate of the experience of the everyday. Infrastructural configurations are then not made durable only through infrastructure's materiality, but also through the labour that keeps them working amidst ongoing decay. These work practices are characterised by precariousness, improvisation, and creativity, highlighting the porosity and flimsiness of infrastructure. Yet, this fragility should not be overstated. Constant work ensures that these historical and quotidian configurations that bring together state, nature, city, and citizen are lasting, even if paradoxically.

To trace these connections a methodological approach attentive to history and the present is needed. If criticisms are made regarding the flattening that sometimes is present in infrastructure studies that also carry out a work of tracing hybrid relations (Carse, 2017a), here I have actively attempted to deepen this query by looking into the past and how it carries on into the present. This is certainly done through archival research but also by paying attention to how workers speak of their own work trajectories and the history of the Lerma System and of SACMEX. As many of them had been working for decades in the system, their memories, and the material devices through which they make these memories enduring beyond their bodies and lifetimes, are also ways of delving into the unfolding and reproduction of socio-material relations, practices and processes in and through

infrastructure and labour. Infrastructures themselves, and their ruination and breakdown are telling of how history unfolds, and how numerous practices of labour and expertise have become intertwined with them across time. Considering infrastructures as material history, in the sense that they materially produce history in their bringing together of diverse socio-material processes, also calls for attention to how labour allows these infrastructures to endure, adapt, or how its absence might imply processes of unavoidable decay.

At the same time, attention to infrastructure and labour furthers empirical explorations of hybridity is made and unfolds. The findings presented throughout this dissertation indeed show that the relations that shape the worlds we inhabit, and ourselves, are hybrid. However, they also suggest that hybridity might not always entail symmetry (Latour, 2005). Throughout this dissertation I highlight how it is the purposeful, creative, and deliberate practice of labour that allows infrastructures to endure. This not to say that materiality is not relevant in the making, remaking, and reproduction of said hybrid relations but that if they are to be analysed as history and in history, as well as contemporarily, the particularity of human work and knowledge is relevant. Neither does this imply that labour operates free from materiality, as workers, engineers, and bureaucrats quotidian and historical practices are shaped and bounded by the flow of water, its presence or absence, the materiality of infrastructures, and the unexpected ways in which they change, demanding action and care.

Finally, this also shows how the worlds in which workers carry out their labour are not freely shaped by them, as they are too embedded in complex infrastructural configurations, which include power relations and hierarchies, material constraints and possibilities, and relations between what can be known and acted upon, and that which remains out of sight and only a matter of speculation. This dissertation looks to develop an argument that follows the positionality of workers in the Lerma System, in a double strategy of situating the enquiry of

urban political ecology as an infrastructural configuration through labour and infrastructure. Through that argument, it looks too to show how a methodological approach attentive to the socio-material relations between sites, temporalities, and human and non-human actors, bodies, objects, and processes, looks in practice. This methodological note lays out some of the main tenets of said approach but to fully grasp how it might look like and what it entails, the reader might need to follow the tracings I propose, and the arguments I make through them.

4. ARCHIVING THE LERMA

“Long has been the struggle sustained during the centuries to supply Mexico City and the Federal District with water. Long and relentless, in which it has been necessary to toughly fight against the elements, in such a way that in many occasions the best calculation had to be rectified, and all provisions fell down.” – Fernando Casas Alemán, Head of the Federal District Government, on the inauguration of the Lerma System (DDF, 1951)

INTRODUCTION

The end of the Mexican revolution saw the rapid expansion of Mexico City gain pace (Rodríguez Kuri, 2012). The city strengthened its position as the symbolic and material centre of the country; home of its largest population; and site of its most dynamic processes of industrialisation and urbanisation (Vitz, 2018). On account of being the capital city of the country, its needs came to be placed at the forefront of numerous state-led modernisation projects. These included the question of water. Certainly, water supply had been a central concern for all previous city governments (Perló-Cohen, 1989; 1999; Legorreta, 2006; Candiani, 2014; Banister & Widdifield, 2016; González Reynoso, 2016), but the scale in which this would be accomplished was on the verge of undergoing a substantial expansion. As the city grew, water had to be brought from ever more distant places through large-scale infrastructural projects. These projects reconfigured more than the process of water supply in Mexico City. They became part of the intertwined production of nature, city, and state – a historically specific set of socio-material relations and infrastructural configurations that can advance our understanding how Mexico City survives and functions today.

In this chapter, I explore the Lerma Project⁶ and System through a two-folded engagement with the archives where it is held. On the one hand, I examine how engineers and bureaucrats made the Project an object of planning, governmental control, and a tool to supply water to Mexico City in the mid-20th Century. On the other, I focus on the diverse archiving practices that shape the Lerma Project as a discrete infrastructural object. The first goal requires an analysis of the many files that document the project, and the various discrepancies, contentions and decisions that can be found following its paper trails. The second one is concerned with archiving as a labour practice that stabilises the Lerma as an object that can be managed, known, and researched. Researching the Lerma in the archives offers some new insights into the history of water urbanisation in Mexico City, a topic that has been the object of much attention across the social sciences in and on Mexico (Aboites Aguilar, 1998; 2009; Albores Zárate, 1995; Banister & Widdifield, 2014; Boehm de Lameiras & Sandoval Manzo, 1999; Cirelli, 1997; González Reynoso, 2016; Gómez Fuentes, 2009; Legorreta, 2006; Perló Cohen, 1999; Perló Cohen & González Reynoso, 2005; Vitz, 2018).

However, its main contribution lies not there, but in exploring how the work of archiving relates to the maintenance of infrastructure and the relations that it enables. Here, I explore two archives, the AHA and an informal archive in a SACMEX office in Lerma. Whilst profoundly different in how they came to be and the role they play in relation to statecraft, official knowledge, and the possibilities of research, they both highlight the relevance of human labour in making these tasks possible. The AHA, as a formal archive, is a window into how official forms of classification, control and knowledge are made. In this chapter, I

⁶ The Lerma Project (or simply referred to as the Project) is the plan to supply water to Mexico City from the neighbouring Lerma Marshes, in the Toluca Valley (Molina, et al., 1949). Here, it is comprised of the different files, photographs, and other documents that described it and sought to shape it in the years of its planning and construction – between 1941 and 1951. It is to be distinguished from the Lerma System, which is the networked infrastructure that was built based on the aforementioned Project, and that still functions today. The System will be analysed in the following chapters.

highlight how this archive was created by the constant labour and will of a group of Mexican researchers, and how this task was eventually brought under direct state control (Aboites Aguilar, 1995; Castañeda Abanto, 2004; Duana, Ríos, & García, 2004). This evidence contributes to our understanding of how the task of archiving constitutes state power and knowledge and of the specific role that labour plays in it. Whilst relatively autonomous from state institutions, the goal of the AHA was to further state control over hydraulic infrastructures, a process that has been thoroughly documented in scholarly literature (Aboites Aguilar, 1998; 2009; Perló Cohen, 1989). The labour-centred analysis I present here contributes to this scholarship by exploring the contingency of this process, in particular in relation to archiving as a process (Stoler, 2002; 2009).

The informal archive at Lerma, and indeed others present across SACMEX offices, allow me to analyse a different set of questions. There, files, plans, documents, and manuals are claims that workers and bureaucrats make not only on state power, but also on the possibility of knowing, managing, and using nature to sustain the existence of Mexico City. Files are not only historical documents that speak of lived pasts and imagined futures, but lively tools that are embedded in the making of the present. These claims are often rooted in a nostalgic reading of the past, as documents become part not of the abstract history of the state and its making, of the urbanisation of water or of the construction of the Lerma, but about the concrete history of workers' labour, the specific infrastructures they manage and maintain, and their role in doing so. As austerity becomes entrenched, infrastructures decay and breakdown, and labour conditions become more precarious, file keeping also becomes a way to affirm the value and relevance of their work in the present, past and foreseeable future. These informal practices of archiving also show an unexplored fact of state making and statecraft; one that moves from the bottom-up and is often engaged in numerous tensions with official ways of doing and knowing.

The chapter focuses mainly on these aspects of archiving as a labour practice that is relevant to understand how infrastructures are made enduring and stable, and how they relate to projects and processes of state making, statecraft and water urbanisation. However, it also develops a subsidiary argument regarding the contents of the Lerma files gathered in formal and informal archives. This functions as a way of exploring the imaginaries, knowledges and practices that were shaping the Lerma System at the time of its planning and construction. I analyse how engineers, bureaucrats, lawyers, and other experts produced water as an abstracted, discrete object that could be known and managed through technical, scientific, and legal knowledge and practice. I show how the goal of this task was to ensure that Mexico City's urbanisation could be furthered by providing 'plentiful water for the city', as a contemporary commentator once put it (Campos Bravo, 1945). In doing so, water and nature are not only made objects but also are subordinated to urban needs. These changes, which follow previous ways of producing hydraulic infrastructures in Mexico and take them to a new site and scale, are relevant beyond the files, as they still shape what the Lerma does today, and are therefore central to understand the context in which the observations analysed here unfold.

A TALE OF TWO ARCHIVES

MOCTEZUMA'S MISSION

There is a small SACMEX office complex next to the aqueduct that carries water from Lerma to Mexico City, a few miles away from the tunnel that leads into the Las Cruces Mountain Range. The buildings are guarded by a policeman and two scrawny dogs. Inside, most rooms are empty, but not all. In one of them there is a self-managed archive on the Lerma System. It is kept by Moctezuma, an administrative worker at SACMEX. Inside the room, numerous plans, files, letters, and photographs are precariously stored in dozens of boxes. Moctezuma cherishes this place. He has plans to transform it into a formal archive. He has spoken to his

brother, who studied library sciences, and he has agreed to help him. He only needs to secure material resources and money, most scarce in SACMEX these days. Other than that, the plan is clear. Shelf space is already accounted for and marked by small signs affixed to several windows. He has also created a very rough administrative structure, which includes an archivist, a document manager, and an ethics code (Figure 7).

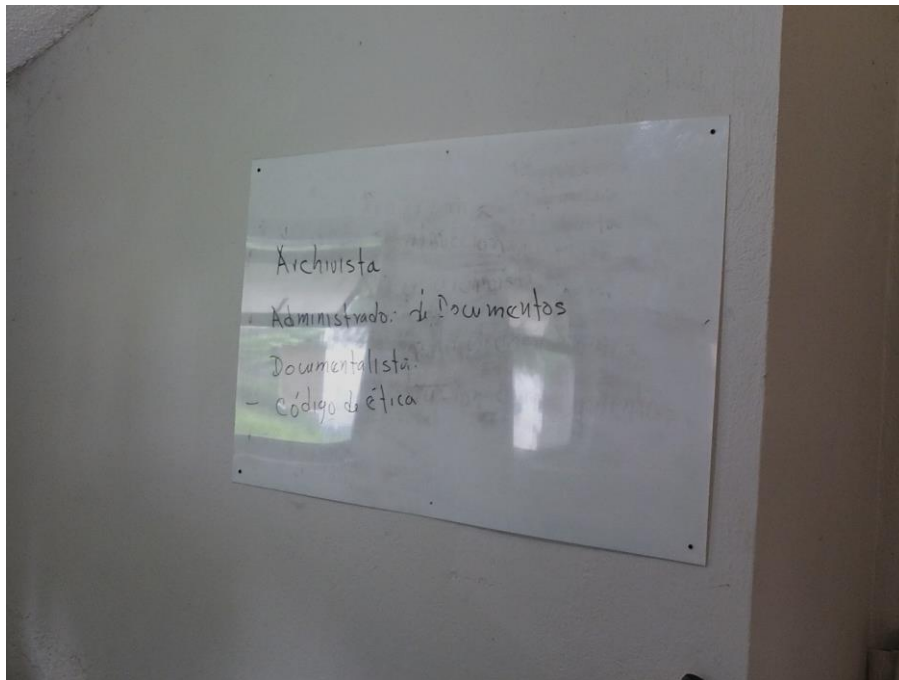


FIGURE 7. MOCTEZUMA'S PLANS FOR HIS SELF-MANAGED ARCHIVE

Moctezuma's own account of his work trajectory might shine some light on the reasons why he undertook the archive as his personal project and can also be a way to understand its broader relevance. He studied plastic arts and interned in SACMEX as a part-time draughtsman. At the same time, he worked as a part-time high school teacher. When he was laid off from this job, he became a full-time SACMEX employee. Then, he passed through different areas, and ended up being an assistant to the current head of the Lerma office. As he told me his story, he emphasised the changes that the Lerma had seen in the past decades. Before, resources were plentiful. Petrol, paper, drawing materials, and personnel

abounded. Workers could effectively monitor the system, both by traveling to remote pumps and wells, and by having on-site workers on a full-time basis. Then, plans and designs were used to guide repair and maintenance projects, and to keep the knowledge regarding the system's infrastructures updated. The past Moctezuma recollected is one of abundance and greatness, which he spoke of longingly.

Things have changed rapidly. Not only has his function as a draughtsman been made redundant, but the once plentiful resources are almost gone. Petrol is now scarce, and cars are mostly parked, even when certain infrastructures should be monitored constantly. Even paper must be rationed, and this is something Moctezuma is adamant on doing; saving money and resources is another one of his personal quests. All these concerns were discussed as I drove down a narrow road in Lerma. Moctezuma travelled in the passenger seat, and Cecilia, a geology student at a local university and a SACMEX intern, sat in the back of the car. Cecilia tried to steer the conversation elsewhere. She asked Moctezuma about the increasing pollution in the local aquifers, and about their rapid depletion⁷. He acknowledged these issues reluctantly, but rapidly went back to his own perceptions of change. Amongst them, he was livid that buildings are now empty, as personnel has decreased, and some old offices have closed. He has plans for many of them: one could be a local health centre; another one could be turned into a school. But one has already an assigned function: it is where the archive is located.

Moctezuma's role as head of the local archive, his self-appointed position within the office, can be understood as a response to these historical trajectories. The Lerma's halcyon days are long gone, and the archives are configured as a present claim on that past. They are a

⁷ Depletion of aquifers in the Lerma area is well documented, and has been partially attributed to the development of the Lerma Project, and the industrialisation that followed it (Maderey Rascón & Jiménez Román, 2001; Esteller & Diaz-Delgado, 2002; Wester, 2009).

way to show that the Lerma once was ran smoothly, precisely, and efficiently, and was central for both Mexico City and the Mexican state. Its importance was such that even the military was in charge of protecting it, Moctezuma reminisces. Now, this relevance is no more. Still working, and still crucial to sustain Mexico City, the Lerma has slid from the public eye, and has ceased to be one of the great prides of Mexican post-revolutionary engineering⁸. The documents he keeps account for the moment in which cutting-edge technology, notions of progress and modernity, and the process of nation-building were made material through the Project. This past is what Moctezuma is seeking to salvage, while he creates a space for his own labour through the process of archiving. It is also a way to understand why he imagines new ways of improving the system, perhaps not with the goal of restoring it to an impossible glory, but to fend off its definitive decay.

While I did not encounter any other self-managed archive of these dimensions, many other SACMEX offices keep small records of past times. These documents range from technical manuals that indicate how certain pumps and tanks were operated, to scientific memoirs published by the System's engineers while the Project was being built. They are normally stored carefully, in designated spaces that are not evident to those who are not familiar with these offices. I got to see and read these documents as I carried out research on current work practices within the Lerma System. As conversations slid from the workers' narratives of their own labour towards my interest in understanding the water system, documents were used as tools to conjure its situated, collective histories. In many occasions, workers emphasised how they had salvaged these diverse documents from destruction. As new bosses came in, they often looked to do away with stored files. Workers selectively kept some of these in an

⁸ In several magazines, documents, and files regarding the Lerma, the engineering relevance of the Project, as the first interbasin transfer in the country, is mentioned constantly. This will be discussed later in this chapter. Conversely, numerous contemporary researchers have argued that the Lerma System is one of the main infrastructural projects of mid-20th Century Mexico (Sánchez-Mejorada, 2005; Vitz, 2018).

effort to make a present claim on the relevance of the System and their labour, particularly in a moment when austerity, decay and aquifer depletion threaten both the grid and the work that sustains it.

These different documents and self-managed archives show the ways in which archiving as a bottom-up process is entwined with ethical and temporal concerns regarding labour, infrastructures, and the state. File keeping is driven by more than mere nostalgia, although its presence is undeniable. It is a way to show how other presents and futures are possible through diverse accounts of better pasts. Those imagined temporalities are populated by abundant resources, precise technological and scientific practices, and budding infrastructures that are at the centre of the state's material making. In contrast to a present of scarcity, and threats of both infrastructure failure and work redundancy, the past speaks of the possibility of revaluing labour and the Lerma infrastructures. It is also a way to elicit a sense of pride in understanding current work practices as a continuation of the titanic labour of supplying water to Mexico City through miles of aqueducts and pipes, and the energy of workers, engines, and pumps. In that way, archiving becomes part of the process of state-making yet carried out not as a form of high planning, but through quotidian actions and practices.

THE HISTORICAL WATER ARCHIVE

The Historical Water Archive (*Archivo Histórico del Agua – AHA*) occupies the building that once housed the National Irrigation Commission, in downtown Mexico City (Figure 8). The AHA building is made of marble-looking stone, covered with graffiti; still, its material grandeur remains, a vestige of the central place the National Irrigation Commission once had in the Mexican state (Aboites Aguilar, 1998). Its wooden main door, now permanently shut, has sunk around 50 centimetres below the sidewalk level since it was built, in 1902. Over the years, the ground in which this building stands has subsided, alongside most of Mexico City's

colonial centre. The new entrance is located on one of the sides of the building, on Balderas avenue. Inside, a policeman, or sometimes two, work as receptionists. They ask visitors to register themselves, leave an identification document behind the counter, and store any backpack they might be carrying. I know this routine well: I visited the archive frequently during 2017 and 2018, as I carried out fieldwork in Mexico City.



FIGURE 8. THE MAIN DOOR OF THE AHA, SUNKEN AS A RESULT OF GROUND SUBSIDENCE IN MEXICO CITY

The AHA is a relatively young archive. Its files were located in 1993 by CIESAS⁹ researchers, working in the project “Water History and Anthropology (19th and 20th Centuries)” (AHA, 1994a). As CIESAS historians investigated the National Water Commission (CNA) files at its

⁹ Centre for Research and Higher Studies in Anthropology

various regional offices, researchers and students organised a copious number of documents that were held in the building that today houses the Archive. These teams found files of great interest and potential in researching water in Mexico, but also encountered them in a terrible state: “many archives have been lost, and others were in appalling conditions (in warehouses, basements or outdoors) [...]” (AHA, 1994a, p. 1)¹⁰. The decision to build the archive was framed as an urgent one, as information on water in Mexico was to be lost completely if action was not taken swiftly.

Action was indeed taken, as researchers presented their findings to the CNA Director General. He took an interest in the project, and in early 1994, a collaboration agreement between the Commission and CIESAS was signed (Castañeda Abanto, 2004). Its explicit goal was to rescue and organise the historical archives found in diverse CNA offices (AHA, 1994a; Aboites Aguilar, 1995). The way in which these files were organised, as well as a general perspective on their contents, was presented through the publication of the Bulletin of the Historical Water Archive, from 1994 until 2008. The Bulletin tells two parallel stories. One is that which concerns the existence of files that were being archived; the second, that of the process of archiving itself. Both can shed light into the ways in which the work of archiving is crucial in making the Lerma a stable object that can be known, governed and researched.

The many files that became the AHA were found scattered in different CNA offices. The documents on Surface Usage¹¹ were stored in the flooded basement of the building that today hosts the Archive. The ones on National Waters, where I found the Lerma Project documents, were kept in boxes at a meteorological station in Tacubaya, a neighbourhood in

¹⁰ Translations on the diverse AHA documents cited in this section are mine.

¹¹ The AHA is organised in seven collections (*fondos documentales*), which group documents on similar topics. These are: Surface Usage (*Aprovechamientos Superficiales*); National Waters (*Aguas Nacionales*); Water Infrastructure (*Infraestructura Hídrica*); Technical Advisory Group (*Consultivo Técnico*); Grijalva River Commission (*Comisión del Río Grijalva*) Papalapan River Commission (*Comisión del Río Papaloapan*), and the Photographic Collection.

Mexico City (Duana, et al., 2004). Some others were found in field offices in, for example, the states of Veracruz and Tabasco. This dispersion shows how the archive was not a fixed space, created as part of a governmental strategy to document, control, and know how, and by whom, water was managed, used, and controlled. Instead, the will to create the AHA was led by researchers, in particular Dr Luis Aboites Aguilar, with the goal of furthering research in the history of water uses in Mexico, to train young historians, and to publish a series of studies in the matter (Castañeda Abanto, 2004).

Yet, the fact that these files were found all in different CNA offices was taken by researchers then as a proof of the centralising trend that characterised the relation between water governance and the state after 1888, and particularly in the post-revolutionary years (Castañeda & Camacho, 1995; AHA, 1996; AHA, 1997; Aboites Aguilar, 1998). As control over water resources was brought under the federal government, documentation around this topic proliferated and became part of the archives of the distinct Secretariats that led water policy in Mexico¹². This, scholars argued, was the reason why documents ranging from Colonial times until the 1970s were found within the various files that make up the AHA. The files were a material proof and a way to tell diverse histories of how the management and control of water resources became a central part of the development of the Mexican state (Aboites Aguilar, 1998).

It is relevant then to notice that the files were not kept in a single archive. For all the centralisation efforts that the state undertook, its control over documentation, as both source and trail of bureaucratic, legal, and political power, was not equally consolidated. Instead, files were found in distant encampments, precariously kept in boxes, or half-

¹² The Secretariats that managed water issues during the main period that the AHA files comprise were: Development, Colonisation and Industry (1884-1911); Agriculture and Development (1917-1946); Hydraulic Resources (1946-1976); Agriculture and Hydraulic Resources (1976-1994), and the National Water Commission (1994-Present).

submerged in stagnant waters. Long forgotten, these documents had to be retrieved by researchers and workers. This situation continued for the following years, as CIESAS remained in control of the AHA by signing annual agreements with the CNA. In 2004, Teresa Rojas Rabiela, who was Director of CIESAS in 1993 – when the AHA was first proposed and given a fixed budget –, challenged the federal government, saying that “it was time that the CNA took over the archive completely, turning it into an institution that is an integral and essential part of it, and not a mere collection that exists due to personal interests.” (Castañeda Abanto, 2004, p. 9)

Rojas’ call was for the AHA to become part of the exercise of state power, and not a classificatory effort that depended on the will of some researchers and scholars. This exhortation problematizes the question of centralisation and state power regarding water resources and the Mexican state. This is not to say that centralisation did not take place. Indeed, the question of water resource use and control was progressively taken away from the control of municipalities, towns, and peasant communities (Aboites Aguilar, 1998). This is certainly the case too in Mexico City (Vitz, 2018), and, as I argue in this chapter, a process that can also be observed in the Lerma Project. Yet, the way in which the archive was made shows that this centralisation was uneven, both geographically – as the lack of documentation from the southern Mexican states indicates¹³ (AHA, 1994b, p. 3) – and institutionally. That is: even if the control of water resources was placed under the federal government, assuming homogeneity and uniformity across its different offices can obfuscate our understandings of both how labour participates in state making through archiving practices.

¹³ As documents were found and organised by CIESAS researchers, they noticed that those regarding the southern states of Guerrero, Oaxaca, Tabasco, Chiapas, Yucatán, Campeche, and Quintana Roo were scarcer. They hypothesised that this might be due to the uneven geographical control by the Federal government, at least in regards to water, in that region of Mexico during the period covered by the AHA files.

It is not exaggerated to draw parallels between Moctezuma's self-managed archive and the many different ones that CIESAS scholars found and brought under the control and space of the AHA. Just as Moctezuma's, those files were kept by workers who found in them a use that the federal government did not consider vital. Moctezuma has, in several occasions, attempted to donate his documents to the central SACMEX offices, who claim they have no space nor resources to take them in. Instead, they are kept in boxes, tied with old ropes, awaiting the influx of resources that made an archive like the AHA possible. There, they also tell the story of the making of the Mexican state. One in which labour materialises the memory of centralisation, enabling its subsistence and the current possibilities of knowing, managing, researching, and governing. This fundamental role can be seen in the ways in which the AHA was put together, and can be read not only through its files, but through its absences. Many projects will not be known as their documents are lost, or precariously kept in an office unknown to scholars and high officials within the government.

The role of labour and expertise, however, is not limited to the present practices of archiving. Its importance can also be read by following the paper trails that make up the Lerma Project in the files that these sites hold. There, numerous experts sought to define what water was, how it could be used, and by whom. These technological, scientific, legal, and bureaucratic discussions and decisions show how the simultaneous production of nature, city, and state was an object of everyday deliberation by numerous experts, workers, and their contentions, claims and counterclaims. These decisions and paths not taken are not confined to the past. They are still unfolding through the Lerma infrastructures, shaping how present labour practices are performed, enabling certain ways of experiencing space and nature, and of carrying out everyday practices of statecraft and water urbanisation. In what follows, I explore these imaginaries, proposals, designs and projects through an analysis of the

documents contained in the archives mentioned so far, and in others that I explored during my time in Mexico City.

THE LERMA PROJECT IN THE ARCHIVES

The Lerma Project paper trail starts, chronologically, at the AHA. It is there where I found the original concession request, made on behalf of the Federal District Department (*Departamento del Distrito Federal*, or DDF) to the Secretariat for Agriculture and Development (*Secretaría de Agricultura y Fomento*, or SAyF). Dated September 25th, 1941, it is signed by Javier Rojo Gómez, Head of the DDF. There, he solicited the use of 10,000 litres of water per second to supply Mexico City. The water would be drawn from the springs on the right margin of the Lerma Marshes, in the neighbouring Toluca Valley. By tapping these springs, the DDF would be able to obtain sufficient water for a growing city. Said water would be used to supply households, and to provide for public services. To do so, a 21-kilometre (km) aqueduct would be built, from the Almoloyita lagoon, in the south of the wetland system, towards the town of Atarasquillo. There, a 14 km tunnel would be dug beneath the Las Cruces Mountain towards the Federal District (DF)¹⁴. Once there, water would flow towards Mexico City, generating electricity in four small hydroelectric plants installed along its path. Finally, the Lerma Project aqueduct would have its end in the Chapultepec area of Mexico City, where a water deposit would be used to distribute water to a thirsty population.

The files that make this history traceable are held in two separate boxes, numbered 232 and 348. The former contains the files that detail the concession request, and the rulings and

¹⁴ The Federal District was the territorial entity that included Mexico City, and existed, in the specific way that is mentioned here, from 1927 until 1997. Its name denotes the fact that it was the seat of the federal government, and as such held a particular status within the Mexican state. In particular, this meant that the Head of Government was not elected, but named by the President. Equally, the DF's budget was assigned directly by the federal congress, which also acted as its main legislative body. The specific implications of this for the case of water will be briefly discussed here. A detailed history of Mexico City and the Federal District, until the year 2000, can be found in Rodríguez Kuri (2012).

deliberations of different governmental offices. The latter consists of the Project's technical documentation, including plans, engineering and economic calculations, and brief narrative justifications of the project's importance and viability. This archiving logic echoes the claims that engineers and bureaucrats were making at the time: that scientific knowledge of water was separate from politics. This separation was predicated on the fact that engineers were merely discovering water's inherent characteristics and using some of its latent capabilities to fulfil a new role for Mexico City. In many ways, engineers and bureaucrats sought to liberate water from its geographical constraints, thus making it realise its potentialities, and finally becoming a tool for progress, development, and the further urbanisation of Mexico City. Politics were not part of their decision, they said, only science and technology guided their actions.

Yet, engineering and bureaucracy did not operate separately. Neither was one prior to the other. Rather, they were developed in a mutually determinant relation that is visible in the Lerma files. There, the DDF bureaucrats, engineers, and lawyers made a claim on the Lerma waters. This goes beyond a mere referencing process, in which lawyers and bureaucrats use hydrological measurements or engineering plans and projections to justify their requests and claims. Engineers produced a tangible, measurable water, one which could be ruled upon and managed. In turn, bureaucrats shaped these calculations and plans, and water itself, by codifying it according to law and its interpretations. Therefore, the Lerma Project is both shaped through technological and legal forms of expertise and labour. These are crucial in defining the sets of measurements, projections, designs and plans regarding water catchments, pipes, pumps, and other infrastructures that seek to fix water as an object of scientific knowledge and technological production. Simultaneously, they enable and define the many legal and political decisions, and provisions that fix water as an object of the law and of state control and management.

To produce water as both a legal and technological object – a natural resource – experts had to follow a double strategy of fixity and abstraction. The Lerma water was fixed by its scientific description, its bureaucratic definition, and its potential utility for the process of urbanisation in Mexico City. This process of fixation involves the making of water into an abstract, quantifiable object, which can be scientifically known and efficiently used. It also allows for its production as a natural resource (Richardson & Weszkalnys, 2014), one which is also dislodged from the many local relations in which it was embedded. In practical terms, this meant that the DDF experts had to deploy at least two sets of resources. One of them was rooted in the legal and administrative dispositions that ruled over water in 1941 Mexico. They implied discussions on the ownership of the Lerma waters, on their lawful uses, and on the ways they should be managed, given their status. The other was framed as a technical and scientific issue, a problem to be solved by engineering, physics, hydrology, and geology. The project is a claim not only on the Lerma waters, but on their ontological and political status.

WATER, INFRASTRUCTURE AND EXPERTISE

The Lerma Project sought to profoundly transform what the Lerma Marshes and springs were. From being distant waters, laying idle or supporting unproductive activities, they were set to become inputs for Mexico City's expansive and intensive urbanisation. Making water into a natural resource required a process of progressive fixation, abstraction, and dislocation. Whilst this process proceeded simultaneously, here it can be divided in three different sets of techniques and discourses. The first one is that of representing water as a measurable quantity. The second one consists of its spatial localization and reorganization. The final one involves a different set of calculations, which can be defined as both economic and moral. All three require the mobilisation of specific forms of expertise, and of particular documents, including plans, calculations, formulas, reports, and requests. Using these

material tools, engineers and bureaucrats defined how much water could be exploited, where it was located and how it could be transported, and why this was done for the greater good of nature, city, and country.

The DDF's claim on the Lerma waters relied, firstly, on the possibility of knowing them. Engineers and experts sought to make water into an object they could measure and utilise. This process required the deployment of quantitative data, which represented water as numbers and flows (Figure 9). Purportedly accurate measurement of rates of flow, surfaces covered by water, and their volumes were deployed in maps, plans, concession request and other official documents. These detail how much water was available at each spring, what was the extension of the Lerma marshes, and how much water each held. This process of defining water as a quantifiable substance lies at the basis of the Project's reordering of nature. Its conversion into a set of numbers is what allows these waters to be brought into a different set of relations. These, instead of being defined by the locality of water – that is, the many situated ways in which riverside populations had used them historically – they came to be determined by their measurable characteristics. Once measured, water could be used in numerous calculations and projections, determining how much water was available for Mexico City.

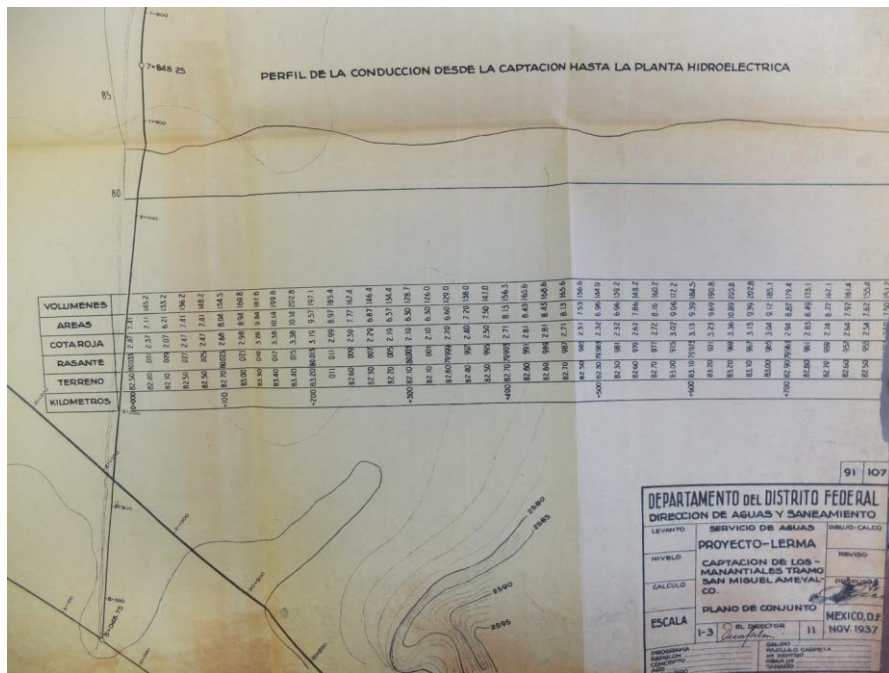


FIGURE 9. DEFINING WATER LEVELS, VOLUMES, AND SURFACES. DETAIL

This authoritative argument was deployed in diverse official documents and reports, through dense sets of formulas, pertaining to economic and engineering calculations (Figure 10), as well as in texts that described the formulas as they claimed that they were accurate measurements and projections, unlike previous efforts undertaken by private companies and city administrations. These forms of argumentation go hand and in hand and acquire their soundness when working together. In tandem they sought to determine how the Project would be shaped and built, and as such are claims on a future that could be planned fully and accurately. Both elements are crucial in the design of the Lerma Project, as its viability was predicated both on budgetary and technical grounds. Engineers and bureaucrats argued that the Project’s suitability was a result of the accuracy of their data, and that the DDF’s concession request had to be accepted on the grounds that it presented a truthful depiction, not only of the existing Lerma resources, but of the ways in which could be effectively used to supply water to Mexico City. In these arguments and formulas, water often slides out of view, yet remains relevant, as it is on the possibility of knowing it and, therefore, efficiently using it, that the whole planning edifice relies on.

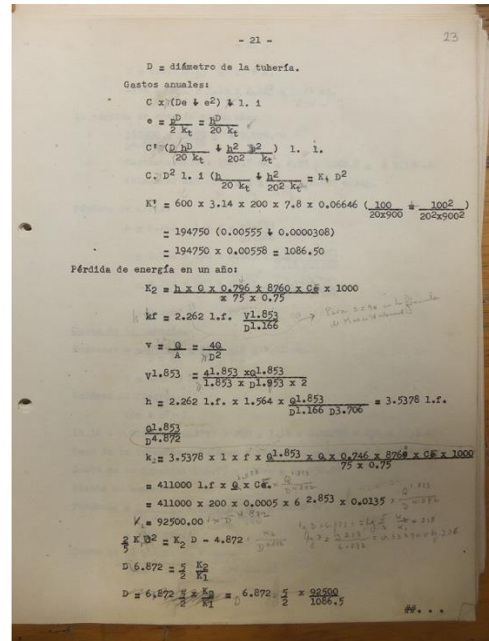
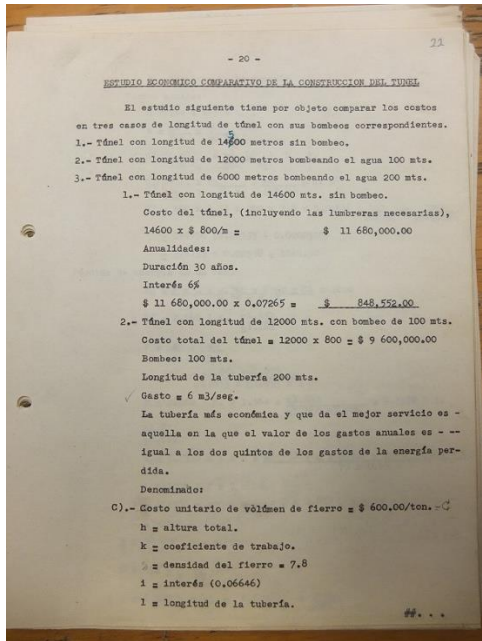


FIGURE 10. MAKING WATER A SCIENTIFIC OBJECT THROUGH ENGINEERING AND ECONOMIC CALCULATIONS

Yet, once the sight wanders off the printed letters, and starts focusing on the notes written with pencil around these supposedly solid numbers and calculations, the precision of these claims seems to diminish. Made by an unnamed SAYF official, these annotations correct the formulas and conclusions reached by the DDF engineers – as seen on Figure 10. These corrections relate, for example, to how energy usage had been calculated, or how long an aqueduct section should be. They resulted not only in higher projected construction and operation costs, but in the need to build the Lerma differently. Moreover, they suggest that the DDF engineers and bureaucrats’ claims on accuracy were not as rigorous as they aspired them to be, and that the purported solidity of their scientific and technological knowledge was instead filled with gaps and cracks. Against their intention of presenting the Lerma Project as a solidly and thoroughly planned claim on water, technology, and their future uses, these contentions reveal the disputed and porous character of its design process. Yet, despite their porosity and contentiousness, the fact that water could indeed be made into a measurable substance, and into the source of numerous calculations and plans remained as

the basis of the Project. That which is called into question here is not the making of water into a resource, but the way in which this can be best accomplished.

The engineers' projections can be further enquired. At the time, these experts could not use their own data. The urgency of supplying water to Mexico City led them to elaborate their calculations based on previously gathered data. In concrete, they were based on two previous surveys of the Lerma Marshes. The first one was in carried out by engineer Fernando Rosenzweig in 1907. Then, he found the springs that ran both to the Lerma River and the Marshes had a flow rate of 9,484 litres per second (l/s). On 1930, engineers Juan Villarello and Rafael Orozco, obtained permission to carry out a survey of the Lerma waters. Their calculations are similar to those presented by Rosenzweig, finding that the springs had a flow rate of 9,968 l/s¹⁵ (Figure 11). These measurements, despite being inaccurate, "half-studied"¹⁶, and lacking well supported conclusions, provided engineers within the Project with some basis to calculate the specific amounts they could expect to capture in Lerma. The claim to accuracy in the Lerma Project was predicated on the future, but it enlisted the past in doing so.

¹⁵ AHA, Box 232. *Manantiales de la Laguna de Lerma*

¹⁶ AHA, Box 348. *Memoria del Proyecto Río Lerma*

*copias del Mapa
Fog. Amara*

SECRETARÍA DE AGRICULTURA Y FOMENTO

ASUNTO: MANANTIALES DE LA LAGUNA DE LERMA.

Superficie según Rosenzweig..... 17,000 Km².

Manantiales	Gasto Rosenzweig	Gasto Villalón
Exahuyocapan.	532 l.p.s.	604 l.p.s.
Pretunza.	140 l.p.s.	159 l.p.s.
Tecocapan.	717 l.p.s.	1042 l.p.s.
Tecolco. Primera serie.	1328 l.p.s.	1508 l.p.s.
Tecolco. Segunda serie.	256 l.p.s.	305 l.p.s.
Tecolco. Tercera serie.	387 l.p.s.	502 l.p.s.
Tecuiltemco.	281 l.p.s.	281 l.p.s.
Acolulco.	707 l.p.s.	707 l.p.s.
Alta Empresa. Primeras serie.	727 l.p.s.	727 l.p.s.
Alta Empresa. Segunda serie.	853 l.p.s.	853 l.p.s.
Alta Empresa. Tercera serie.	1177 l.p.s.	1177 l.p.s.
Alta Empresa. Cuarta serie.	1051 l.p.s.	1051 l.p.s.
Exahuyocapan.	122 l.p.s.	122 l.p.s.
Chapultepec.	474 l.p.s.	474 l.p.s.
San Miguel Atoyacalco.	---	73 l.p.s.
Alfez.	---	55 l.p.s.
Topoaco.	69 l.p.s.	---
Topoaco. Bajo.	9 l.p.s.	---
Tillapan. (San Cayetano).	189 l.p.s.	---
Bullipan.	5 l.p.s.	---
La Sranja.	5 l.p.s.	---
Dofa Rosa. Primera serie.	4 l.p.s.	---
Dofa Rosa. Segunda serie.	5 l.p.s.	---
Dofa Rosa. Tercera serie.	4 l.p.s.	---
S u m a s	9780	9264

A P O R O S :

Puente de Atenco.....1450 l.p.s.
 Puente de Lerma.....6586 l.p.s.
 Puente de San Bartolo.....6135 l.p.s.
 (Ing. Guzmán 9 de enero de 1907).
 Puente de Solis.....2810 l.p.s.
 Eng. Rosenzweig 1 de enero de 1907).
 Fuente de Toshi.....9030 l.p.s.
 (Ing. Rosenzweig enero de 1907).
 Aforos en el Puente de San Bartolo durante 1907.
 Enero.....2810 l.p.s. Gasto medio.

SECRETARÍA DE AGRICULTURA Y FOMENTO

ASUNTO: Hoja número dos.

Febrero.....	1830 l.p.s.	Gasto medio.
Marzo.....	590 l.p.s.	Gasto medio.
Abril.....	517 l.p.s.	Gasto medio.
Mayo.....	630 l.p.s.	Gasto medio.
Junio.....	1000 l.p.s.	Gasto medio.
Octubre.....	2190 l.p.s.	Gasto medio.
Noviembre.....	1210 l.p.s.	Gasto medio.
Diciembre.....	1070 l.p.s.	Gasto medio.

La cuenca del Lerma hasta el puente de Toshi tiene 4700 Km². (Ing. Rosenzweig 1907).

MEX/oa.

FIGURE 11. MAKING WATER INTO A SCIENTIFIC OBJECT: THE ROSENZWEIG AND VILLARELLO SURVEYS

Quantifying the Lerma waters was not a sufficient condition for them to be made part of the Mexican state's push for development and progress. At the same time, their specific location had to be determined and reorganised. In this task, maps and plans were called upon. Through them, engineers sought to visualise the fact that water was now an abstract substance, susceptible of being brought into a new set of relations determined by the need of supplying water to Mexico City. In these maps and plans, springs are fixed in a homogenous space (Craib, 2004). Whilst towns, topography, and other geographical features are part of them, they are made part of a new set of relations. These are characterised by their articulation around the aqueduct and reordered according to their role in the Project. Springs become readable only as an input to water supply for Mexico City; mountains matter insofar the aqueduct must pass through them, and towns are shown as agglomerations only relevant in their relation to different water infrastructures.

This spatial reordering is part of the Project's reconfiguration of the socio-material processes entangled in resource making, and the production of a new urban political ecology through

its infrastructures, geared towards the goal of supplying water to Mexico City. Once fixed in space and time, water is abstracted from the local set of relations of which it is a part of. Almoloya¹⁷ (Figure 12), for example, ceases to be a space inhabited by humans and non-humans and their many relations, and instead becomes a dot in a map, associated to a determinate water flow rate. Once portrayed in a map, the possibility of fixing it again into a new set of relations becomes possible. It is on the plan and the map where the Lerma Project as a whole becomes visible and graspable. There, quantities and places become subordinated to the networked infrastructural system, and, in turn, to its final destination: Mexico City. Water becomes able to fulfil its role in advancing towards a future of progress and development by virtue of its dislocation and subsequent relocation. Abstraction means that it is possible to switch the Lerma waters from a local scale towards one centred on the urban process and brought about by state-led planning and infrastructure construction.

¹⁷ Almoloya is both a spring and a town in the Lerma region, located in the south of the Lerma System.

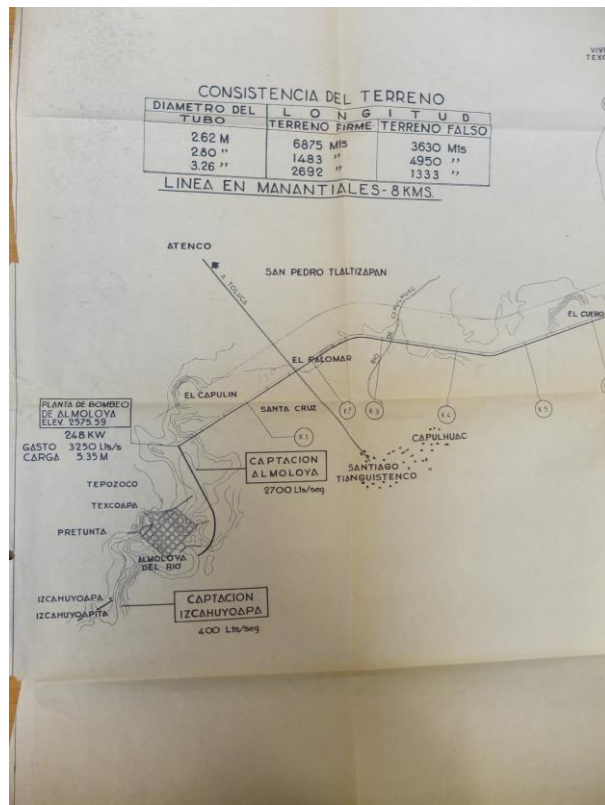


FIGURE 12. REORGANISING ABSTRACT SPACE. DETAIL OF LERMA PROJECT MAP

This modernising process, and its moments of quantification, location, fixation and abstraction, is not merely a technical or scientific project. Central to it is the articulation of a moral discourse, which is present in the very language of engineering and science. An idea that appears repeatedly in the Lerma Project is that which states that through it, idle waters are being made productive. It was argued that the Lerma marshes waters were being lost due to evaporation, resulting in an economic, social, and moral loss. There, the possibility of tapping on their unused potentiality was imbued with a moral vision. This becomes clearer once the idea of idleness is questioned. As it has been abundantly researched, waters in Lerma were not merely evaporating, or being unused. They were the basis of a complex set of relations based on the exploitation of lacustrine resources, and their management, which had been recorded as present there since the 18th Century, but that might reach back further in history (Albores Zárate, 1995; Cirelli, 1997; Camacho Pichardo, 2007). Idleness therefore

was associated with ways of producing and living that were considered non-modern. The future was not populated by fishermen, craftsmen, and peasants, but by industrialisation, urbanisation, and full mastery over water and nature.

Through these intertwined processes of fixation, abstraction and dislocation, engineers sought to make water into manageable natural resource. They claimed that this was possible on account of the precision and soundness of their calculations and plans. Yet, a closer look to the documents that record this task, claims on accuracy seem to be diminished. As engineers were claiming to possess the correct understanding to fully plan the way in which state had to use and manage water (Molina, 1939), they were obscuring the fact that this knowledge was disputed, patchy, and often inaccurate. Displacing these contentions was instrumental for them to claim that it was through engineering that rational use of water in the service of Mexico City was possible. It also allowed them to place themselves at the centre of the task of modernising country and city (Orive Alba, 1947), one that could be achieved by quantifying, locating, and efficiently utilising water. This was the task of taming nature by making it predictable, useful, and rational. Despite their own claims, however, engineers were not alone in this making. They were working, often reluctantly, with other expert knowledges and ways of doing. These, alongside engineering, were also needed for the state and the city “to marshal the productive forces of nature and of the unruly people who live in its midst.” (Hetherington & Campbell, 2014, p. 193)

BUREAUCRACY’S NATURE

Nature was not being tamed only through scientific and technological measurements, instruments, and narratives. The Lerma Project was also a way to make water into an object of bureaucratic control and legal definition, and this included a different set of experts. Lawyers, DDF functionaries, and federal government officials sought to define who owned water, who could use it and what for, and who oversaw its management and administration.

Through these forms of expertise and knowledge, water was becoming fixed as a scientific object, as a resource that could be appropriated through diverse infrastructures, and as a substance that was under control of the Mexican state. In doing so, experts and workers were also producing or cementing specific institutional relations within the state through bureaucratic processes and practices, often beyond existing legal provisions, as I will discuss in this section. By defining which uses of water concerned the federal government, which were the responsibility of the DDF, and how these functions were to be carried out, these forms of labour shaped the city and the state as it fixed water and nature. This process is clearly visible in two parallel discussions that run through the files: one concerns the different potential uses of water, and the other regards the legal and administrative status of the Federal District.

The DDF's Lerma Project concession request states that the 10,000 l/s that were solicited would solely be used for public services, which seemed to include household supply. This straightforward argument was immediately called into question by the SAYF officials in charge of reviewing the request, and eventually approving it. Above the lines in which purported uses are stated, a functionary wrote with black paper "production of electricity destined for"¹⁸ (Figure 13). This meant that the concession was, in fact, not merely about household supply and public use, but centrally one to produce energy. This is certainly clear in the Project's technical documentation, where the plans to build four hydroelectric plans are richly elaborated. These were not simply add-ons to the Project, but instead were instrumental in making it financially viable, as it would be through selling energy that the DDF would build the Lerma as a self-sustaining, or even profitable, venture. The Project's economic plans argue for this, and all cost-benefit analyses are based on this premise. Out

¹⁸ AHA, Box 232, p. 1

of the many abstractions that water was made into, that which transformed into money was the one that cemented the future functionality of the Lerma System.

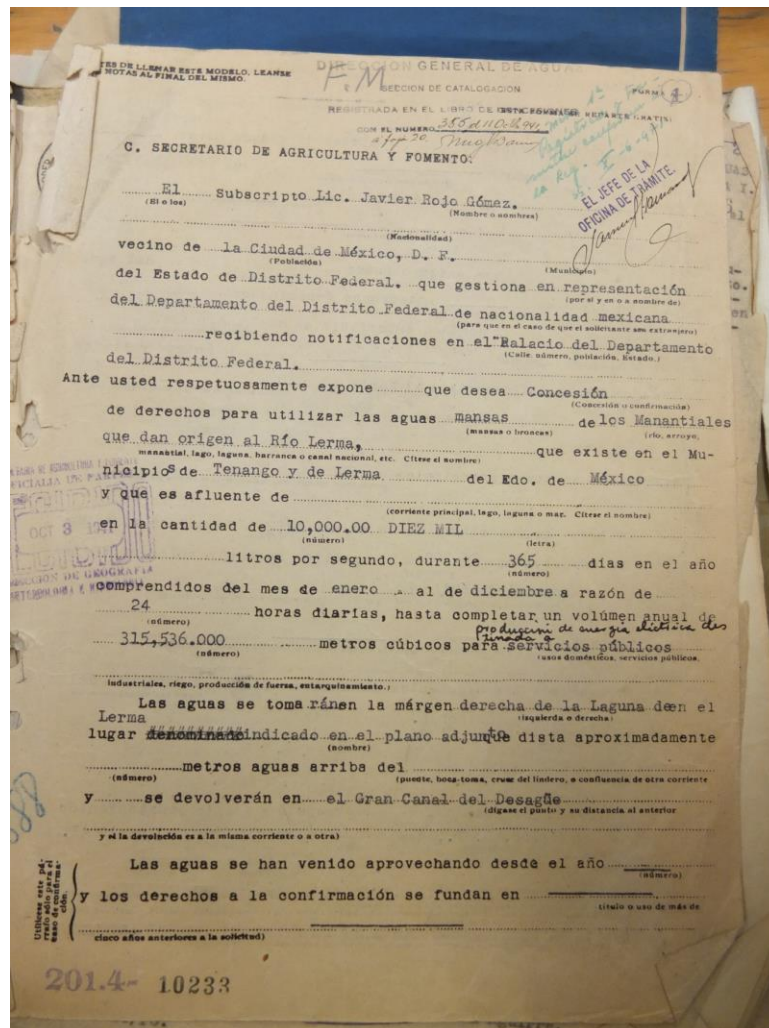


FIGURE 13. ARCHIVAL CONTENTIONS IN THE LERMA CONCESSION REQUEST

This, however, would prove problematic. Commercial electricity generation and household water supply were ruled by different sets of legal dispositions. The former was regulated by the federal government (de la Garza Toledo, et al., 1994), and was carried out both by public and private companies, whilst the latter was decidedly a local and public endeavour. Moreover, local governments, such as the DDF, could not produce energy as a commodity to be sold, only to supply their own public services. This is the root of the clarification made by the SAYF official on the Lerma Project request. It pointed out that the DDF could not make a

single request for water and electricity generation, but rather two. In the case of latter, furthermore, the concession had to be granted not by the SAYF, but by the Federal Electricity Company (*Compañía Federal de Electricidad – CFE*), who acted as the sector regulator. It was to them that the DDF request had to be made, as the plans to generate electricity should not interfere with CFE's electrification strategies¹⁹, and should not have a commercial goal. This, certainly, could have profound consequences for the Lerma Project, as its economic underpinning was cast in doubt by these decisions.

The question of how to fund the Lerma Project was, therefore, not without trouble. If future electricity generation would be the source of income that would make the Lerma sustainable, the question of how to finance its construction remained unanswered. In other cities in Mexico, where budgets were tight, this issue was carried out by resorting to federal loans, given by a number of public finance institutions, including the National Mortgage Bank, and Urban Mortgage and Public Works Bank. These allowed small cities to develop their local water infrastructures in a push to extend urban water supply in the country (Jiménez Lopez, 1953). During the 1940s and 50s, when the Lerma was built, the development of municipally owned and ran water supply systems was central to the Mexican state's push for modernisation. A publicly owned, centrally managed, networked set of infrastructures were part of the period's infrastructural imaginaries²⁰. These were being

¹⁹ AHA, Box 232, pp. 25-26. In the 1940s, impulse to public generation of electricity was given, as the sector was rapidly developed as part of a broader governmental strategy of industrialisation and electrification (de la Garza Toledo, et al., 1994)

²⁰ As it will be argued towards the end of this chapter, there was an infrastructural imaginary being developed through diverse projects, such as the Lerma. This imaginary involves both nature, city, state, and coalesces around infrastructures. It is decidedly modern, insofar it puts forward a set of networked infrastructures as its notion of desired future (Graham & Marvin, 2001), but also presents some particularities, perhaps related to the city's position not only within independent Mexico, but as part of a longer colonial history (Candiani, 2014). Amongst other relevant questions, this means that, even if the narrative part of this imaginary proposed full coverage of water services to the city, in practice it often limited itself to the former colonial core, and to the bourgeois neighbourhoods that sprouted around it during the Porfirian period (1876-1911). These entangled histories define much of the material disposition of water infrastructures in Mexico City and its hinterlands, as it will be argued in the next chapter.

portrayed as the markings of a truly modern Mexican city, with the capital as its vanguard, and a goal to be reached as soon as possible. The question, then, was how Mexico City could reach this objective.

When the concession was initially requested, it was not yet defined who should fund the Project. This lack of definition stemmed from the particularity that the DF was the seat of the Federal Government, and directly dependant on it. As such, it was unclear if the concession request was to be interpreted as one made by the local or by the federal government, and therefore whose budgetary and operational responsibility it was. In disentangling this juridical question, the DDF request went through several offices within the SAYF. It bounced from the desk of the Direction General of Water, made its way to the Consulting and Legal Department, and was ultimately analysed by a hired consultant. His job was to determine if the Federal District was indeed separate from the Federal Government, and to clarify what this meant for the Lerma concession request. This highlights the role that labour and expertise, as contentious everyday practices, have in processes of state making, water urbanisation and infrastructure provision.

Quoting the Law on Nationally Owned Waters, the analysis determines that the nation is the legitimate owner of the Lerma waters, and indeed of nature, and that its sovereignty over it partially defines what the nation is. However, the consultant argues, this sovereignty is not direct, but rather mediated through the state apparatus and its numerous organisms and dependencies. In the case of the DF, this presents a particular issue. Yes, it was true that this district was part of the Federal Government, and that it was indeed ruled by the president, even if indirectly through the Head of the Department. Yes, it was accurate to say that Mexico City was a direct part of the Federation, but this did not mean that the city was the Federation itself. Its particular status was not due to any essential characteristic the capital had, but precisely because it hosted, as a contingency, the Federal powers. If these were to

be moved elsewhere, the DF would cease to be identified with the Federation, to become another state within its Federal pact. In the case of water supply, this meant that, even if the nation was its owner, the institution that had the obligation to finance, manage, and build the Lerma Project was the DF.

This dual legal and administrative status of the Federal District is key to understand how the Lerma Project was ultimately shaped, and how it becomes intertwined with the making of the Mexican state. On the one hand, it was always prioritised as it served the capital of the country, where the modernisation of the republic was being devised and designed. On the other, it could not be built by the Federal Government. Instead, it was the District that was in charge of doing so. To secure funds, the government used its own budget, as well as a loan from the Urban Mortgage and Public Works Bank, that amounted to \$42,630,000 Mexican pesos, or 19% of the total cost of the Lerma Project, which rose to \$225,607,737 (Departamento del Distrito Federal, 1949; Jiménez Lopez, 1953). As mentioned before, this is equivalent to £321,581,192 pounds sterling today, considering inflation rates. To pay back the loan, and to recover the expenses made by the Federal District government, the question of hydroelectric power was crucial. It was through selling energy that the Lerma Project became cost-effective, as water tariffs were low and insufficient to allow the project to run on black numbers.

For three years, from 1941 to 1944, the concession requests were object of multiple discussions between the DDF and the federal government. Not only was the question of determining if the City was a fundamental part of Federation being argued. The Federal Government sought reassurance that the DDF would not generate electricity to be sold. This not only implied requesting two separate concessions, one for water and one for electricity. It also meant that the DDF experts had to project not four hydroelectric plants for the Project, but only two. With this, they sought to assure other bureaucrats that their project complied

with the law – even when it did not. The final approval for using water both for electricity production and public and household supply was given between February and March 1944. The official documents were published in the Federation and the State of Mexico official journals²¹, and allowed the DDF experts to explore the terrains where the Lerma Project would be built. Both usages – electricity and household supply – were approved, even if separately. Yet, the approval came two years after the works were already underway, with sections of the aqueducts, tunnels, and filtration galleries already built. This much can be read once the paper trail of the Lerma is followed not in the AHA, but in the Mexico City Historical Archive (AHCDMX)²². Ultimately, the hydroelectric plants were never built, and this resulted in the Lerma System becoming a source of endless deficit for successive Mexico City Government administrations, until today.

The fact that concessions were approved, even if the Project had been long underway, shows that these were not an effort to regulate the environmental action of the DDF in advance. Instead, they were a form of reigning in its ongoing development. This distinction is relevant to understand how law, administration, nature, and infrastructures become entwined in the Lerma Project. The plethora of administrative documents that are archived at the AHA, and elsewhere, are not the reports of a process in which the Mexican state is defining what water is, as a way of making it into a fixed resource that can be appropriated. Instead, they can be read as the opposite: they are traces of a process in which the Mexican state was being made through different infrastructures, and through associated labour and expertise practices,

²¹ AHA, Box 232, pp. 46-97

²² The Lerma Project documents in the AHCDMX are scattered in dozens of boxes, without any thorough classification. They have been stored as they were found in different offices, and only very limited catalogues are available. The few documents I was able to locate cannot form a coherent story; they include copies of payrolls from the 1940s; a contract signed between the DDF and the Hidalgo Construction Company to measure and project filtration galleries in Lerma in 1941, and some plans that mention the Lerma Project, but do not discuss it in any depth. However, the annual reports made by the Head of the DDF office state that the Lerma was under construction since 1942, and certainly well on its way by 1944.

that sought to regulate an already underway process of water making and appropriation. These tools include the different laws, technologies, and scientific principles that sought to define what water was, and that framed the task of supplying Mexico City through the Lerma Project as a legal, modern, rational, and accurate one. As the state was being made, nature was defined as an object to be used, known, and measured. These socio-material processes advanced simultaneously, being constantly fixed by diverse experts and their claims on the nature of water, the city, and the state. Against the multiplicities of water, its local relations and histories, an urbanised, abstracted, and stabilised version was put forward through by the Mexican state through the Lerma Project and its experts.

PLENTIFUL WATER FOR THE CITY

In 1945, a group of Mexico City journalists travelled to the Lerma Marshes, invited by the president, Manuel Ávila Camacho. Upon their return to the city, they penned a number of articles in some of the capital's most read newspapers. They reported that the works would be finished by 1946, before the new president was sworn in, and that they would finally solve Mexico City's water woes. The Project was deemed "one of the most daring engineering works in the world" (Villeneuve, 1945), and it was promised that the Project would provide "plentiful drinking water, not only for its current necessities, but for those of up to eight million inhabitants" (Campos Bravo, 1945). The newspapers highlighted the fact that these works would be a definitive solution not only to the problem of supply, but that they would also stop the problem of subsidence, as new water wells would not be dug anymore. The works were called cyclopean, of the utmost necessity, and were framed as the result of the singular will, inventiveness, and determination of the Mexican engineers, bureaucrats, and experts that shaped it. Through the Lerma, the present and future of Mexico City was secure.

The imaginary that these journalists are writing through was not of their own making. Defining the Lerma Project as a grandiose undertaking was rooted in the ways in which nature, technology, city, and state were thought of at the time when the Lerma was being built. This imaginary was centred on infrastructures, which were seen as heralds of a modernity yet to come, but decidedly on its way. These forms of thinking circulated beyond journalistic circles. They were also found in the state experts' reports and proposals about the Lerma Project, and in the broader scientific and political discussions of the time. Moreover, their presence was not a spontaneous appearance, but the result of longstanding historical trends, which also involve the state, expertise, nature, and the city (López, 2012; Candiani, 2014; Perló Cohen, 1999; Romero Lankao, 1999; Vitz, 2018). The modern infrastructural imaginaries of mid-20th Century Mexico City are both a product of history and part of its making.

As part of the piecing together of the Lerma Project, I consulted numerous magazines, journals, newspapers, and other historical documents. I did so in the AHA, the AHCDMX, and in the library of the Geology Institute, at the National University of Mexico. There I could trace the wider milieu in which the Lerma Project was proposed, the scientific disputes that were prevalent at the time, and the powerful pull that the process of urbanisation had in defining how Mexico City would secure its water supply. In this final section, I will describe these broader historical trajectories, as a way to understand why the Project was designed as such, and how it became part of the longer history of urbanisation in Mexico City. I also discuss further what the relation between Mexico City and the Mexican post-revolutionary state was, and how the Lerma Project was also instrumental in shaping it, beyond that which is stated in law, and defined by science and technology. The section examines the infrastructural imaginaries that characterised discussions about nature, the state, and Mexico City around the time when the Lerma was projected and built.

INFRASTRUCTURAL IMAGINARIES IN MID-20TH CENTURY MEXICO

If journalists did not construct their narratives about nature and infrastructure on a vacuum, neither did the DDF experts and engineers in charge of the Lerma Project. Instead, they were working embedded in broader circuits of knowledge production and technological practice. Their notions of what water was, how it could be appropriated, and why this had to be done, were shaped by wider histories of expertise, urbanisation, and state formation. Whilst these certainly operate in distinct scales, they were present in the many discussions that informed engineering knowledge and practice in the period when the Lerma Project was being built. These arguments were often played out in diverse technical and scientific publications. There, DDF experts, alongside other engineers and architects, put forward their visions of how nature, city, and state were related and debated their role in this historical entwinement. Here, I discuss the arguments made in two leading journals of the time: the Mexican Journal of Engineering and Architecture (MJEA)²³, and Hydraulic Engineering in Mexico (HEM)²⁴. In the case of the latter, I covered the 1947-1953 period; in the former, the one between 1939 and 1954.

In both journals I trace the different ways in which the aforementioned relations were portrayed, conceptualised, and discussed. Water, as part of nature; the city as a human production, and the state as the entity in charge of managing and organising both, were often discussed together. The staunch divisions that were present in the Lerma Project here become subtle, without them disappearing completely. Paradoxes and contradictions abound. Nature appears both as something that must be tamed, and something that must

²³ In Spanish: *Revista Mexicana de Ingeniería y Arquitectura*. This was the journal of the Mexican Society of Engineers and Architects, arguably the main organisation for these professions at the time.

²⁴ In Spanish: *Ingeniería Hidráulica en México*. It was the official publication of the Secretariat of Hydraulic Resources (SRH, in Spanish), which, in 1947, took over the water-related topics from the Secretariat for Agriculture and Development, now renamed Secretariat for Agriculture and Livestock.

be cared for. The emphasis different experts place on these ways of relating to what they perceive as being an external and essential nature change, but these two poles often appear entwined²⁵. This double relation seems to be shaped by the perceived nature of water in relation to Mexico City, which is discussed abundantly in these journals. The question is conveyed through a language of struggle and impending calamity, in which water is defined as a two-pronged problem. For example, Eduardo Molina, Head of Public Works at the DDF until 1946, and then also Director of the Lerma Project, wrote in 1939:

“In the many centuries that Mexico City, and the populations that today are found within the Federal District, have existed, there has been a constant struggle to obtain water to satisfy its inhabitants’ needs, or to defend from it when it becomes a destructive and harmful element.” (Molina, 1939)

Another contemporary commentator argued something similar, granting it an almost mythical character:

“Then [after the basin was closed due to volcanic activity, long before it was populated] our Valley was turned, as the engineer Don Francisco de Garay²⁶ used to say, into an immense volcanic mouth, dotted in its centre and its contours with a multitude of extinguished craters, dwarfed by the giant Popocatepetl, whose tenuous crest of white fumes is lost in the clouds. That condition of closed basin in which the Valley of Mexico was left has been the origin of all misadventures that this Valley has had in the course of times [...]” (Pérez-Castro, 1954, p. 22).

This diagnosis was, and is, widely shared. Water, as the substance that sustains life and its main threat, defines the whole history of the city (Vizcaino & Bistrain, 1952). Excess and lack are the two conditions that water presents for the city, a problem derived from its very conception (Durán & Becerril-Colín, 1948). These are, more than opposites, two sides of the

²⁵ This was the case too in Porfirian Mexico, when the expert elite framed the problem of nature in the Valley of Mexico as one of both conquest and care (Vitz, 2018)

²⁶ Francisco de Garay was the head engineer in charge of designing and building the main drainage project of 19th Century Mexico City, up until 1882 (Perló-Cohen, 1999; Candiani, 2014)

same coin, even if, historically, the problem of flooding and excess precedes that of scarcity (Secretaría de Recursos Hidráulicos, 1948). From the onset, these issues demanded specific ways of expertise, which were now placed under the responsibility of the engineer (Molina, 1939). It was he – and it was most decidedly a “he”²⁷ – who had always led the struggle against this double-edged problem, developing ever more daring solutions, which always promised to be definitive and everlasting. To do so, engineers needed to generate accurate knowledge. Science was the tool that they had to understand the problem, and thus devise a correct solution. This understanding was not only of water, but concerning demography, geology, and history. The knowledge needed to provide efficient responses to Mexico City’s water problems was integral, but always subordinated to human needs.

These human needs were defined in two interconnected ways. One had to do with the question of household supply. The goal that most of the proposals to supply water to Mexico City had was to increase the available water per inhabitant, per day. Ideal amounts were put forward. In 1939, Eduardo Molina, who would eventually lead the Lerma Project, proposed an ideal supply of 500 litres (1939), as Durán and Becerril did in 1948. (1948). In 1952, two engineers working in the Hydrologic Commission for the Mexico Valley Basin argued for an identical quantity (Vizcaino & Bistrain, 1952). Their vision of a water rich city was shared widely, even if other experts imagined a less exuberant future, setting 300 to 370 litres as reasonable goals (Arenas-Valdés, 1948). The DDF set their own goal in 400 litres, a calculation based on the United States case, where the average supply was 620 litres (Perló-Cohen, 1989, p. 27). The vision of the future of water in Mexico City was one in which every

²⁷ Language regarding the task of taming, conquering, protecting or using nature is riddled with gendered analogies and narratives. The many tasks that engineers carry out are usually referred to as “manly” (*viril*), and nature appears as a feminised object that they can relate to in different ways, but always subordinated to them, and to the tasks of modernity and civilisation.

household would have sufficient water to live in a manner according to that of cities in the United States²⁸.

The second way in which human needs were defined, insofar it concerns the question of water and Mexico City, has to do with the place that the Mexican capital held in the infrastructural imaginaries of the period. For engineers writing in these journals, this place was one of prominence and utmost importance. An engineer from the period framed this in the following way:

“The Valley of Mexico is undoubtedly one of the regions in our country that, from time immemorial, has, and will continue to deserve special attention in the solution of its numerous hydraulic engineering problems, insofar it is the seat of Mexico City.” (Arenas-Valdés, 1948)

The centrality of Mexico City was rooted, then, in history. It had been for centuries the source of political-religious power in the country (Vizcaino & Bistrain, 1952), and it was this standing that was at the root of all its woes. Being built in the site of a former closed basin, it was condemned to suffer from both excess and lack of water. This fact was compounded, in mid-20th Century Mexico, with its role in the industrialisation of the country. The capital was being the centre of the regime’s push for modernisation, not only as it was the seat of political power, but, according to some commentators then, due to its natural characteristics. Warm winters and cool summers, and the abundance of natural light reduced the need for electricity, making industry more profitable – insofar water supply was secured (Durán & Becerril-Colín, 1948, p. 107). Human needs here come to mean the furthering of the conditions that would allow capital accumulation to continue, and strengthen Mexico City as

²⁸ It has been argued that these calculations did not respond to the lived realities of the Mexican capital, but to the desires and aspirations of its scientific and political elites (Perló-Cohen, 1989)

it was “in the Valley, it can be affirmed, without any trace of doubt, that, from it, all life in the country springs.” (García-Quintero, 1951, p. 121)

For all its importance, Mexico City had not ever seen what engineers considered a modern water supply system. In 1953, there had been only six years of 24-hour water supply, and this was limited to the reduced main distribution network (Jiménez Lopez, 1953, pp. 84-85). Bold solutions were being called for regularly, as Mexico City had been long thrown into a state of permanent hydrologic imbalance. The issue, then, was how to restore equilibrium, and what equilibrium actually was. The former question had a unanimous answer: it was through science, technology, and the building of large infrastructures that balance could be achieved. The question of what equilibrium represented was disputed, although some general notions existed. The general idea was that water had to flow in such a way that the city had as much water as it needed, and that it returned a sufficient quantity back to nature, so that aquifers, rivers and forests could survive.

How to do this was not such a straightforward question. Most engineers came to see the scale of Mexico City not as contained by the Valley but spreading far beyond it. As Mexico City’s water demand increased, distant sources became desirable. The Lerma Marshes had indeed been part of this infrastructural imaginary long before the Project was finally approved and designed. Since 1902, and throughout the 1920s and 30s, the marshes had been object of different concessions, which were either rejected, or could not be built due to diverse constraints²⁹ (Perló-Cohen, 1989; Camacho Pichardo, 1998; Vitz, 2018). Other

²⁹ The first numbers come from 1902, when an American businessman called William Mackenzie proposed to use the evaporating waters of the Lerma Marshes to supply Mexico City. His project, a private enterprise, was rejected by Mexico City planners then, as it both did not adhere to the public ownership ethos that was dominant in regards to water, and it promised cheap, but poor quality water – at least in comparison to the one available in Xochimilco (Vitz, 2018).

sources in the states of Puebla, Veracruz, or further away in the state of Mexico were already being presented as future fixes for the problem of scarcity, as the city continued to grow relentlessly. The notion of equilibrium that these experts held was no longer contained to the scale of the basin, but operated in a broader way: as the “virtual Mexico Valley Basin”.³⁰ (Pérez-Castro, 1954, p. 32)

This was certainly not the only plan existing then. Others were put forward, as it had happened before³¹. It was argued that importing water from other basins would not solve the problem of scarcity, excess, and subsidence – the three faces of the Valley’s disequilibrium. Instead, a solution still rooted in the level of the basin had to be found. This took different forms, but two stand out from the discussions held in the journals analysed here. One saw in rainwater the solution for Mexico City’s water problems (Durán & Becerril-Colín, 1948). The other proposed to tap water running off the two main Valley volcanoes: Popocatepetl and Iztaccihuatl (Vizcaino & Bistrain, 1952). Both implied further differentiating water through infrastructural interventions. Instead of mixing rainwater, runoff water and wastewater in the city’s sewage, they proposed to separate them. This separation could be done in two different ways. One was to build separate pipes and reservoirs for clean water. The other required the construction of large water treatment plans. Moreover, both required

During the 1920s, two other concession requests were made to use the Lerma waters to supply Mexico City. In 1920, Benjamín Hill and Miguel Gómez requested to use 2,100 l/s to supply Mexico City’s public and domestic requirements. In 1923, another American businessmen, Andrew Macken, requested 3,000 l/s with the same purpose. Both projects were rejected, as the federal government was reluctant to grant permission to exploit these waters to any private company (Camacho Pichardo, 1998). Around 1930, engineers Juan Villarelo and Rafael Orozco, obtained permission to carry out a survey of the Lerma waters. They could not carry it in detail, and the project, “judging by its plan it appeared to be merely a sketch”. (Oropesa, 1943, p. 242)

³⁰ The notion of an expanded basin has been recovered in recent scholarship, which argues that the hydrological cycle in Mexico City must take into account its water infrastructures, and can be thought of in the scale of a *hydropolitan region* (González Reynoso, 2016).

³¹ The decision to desiccate the Valley was too subject of numerous debates and disagreements. These related not only to questions of engineering, but often addressed matters of ecology, economy, and politics. The management of water in Mexico City is historically intertwined with its governance and political ecology. This questions have been researched in previous periods of history, often in relation to infrastructural projects (Camacho Pichardo, 2007; López, 2012; Candiani, 2014; Vitz, 2018)

“abandoning completely that old prejudice that has existed against rainwater, and instead of throwing them outside the Valley, they must be used to the maximum possible at any cost” (Durán & Becerril-Colín, 1948, p. 111). This meant using the drainage only to eliminate water excess, as originally intended, instead of making into a tool for disposing of all Mexico City’s disposed water (García-Quintero, 1951, p. 123).

These calls for producing a different urban water were not heeded. Instead, the plans to appropriate water not only from Lerma, but also from other, more distant, places became the hegemonic strategy of Mexico City’s experts and bureaucrats in their task of supplying water to Mexico City (Perló-Cohen, 1989; Legorreta, 2006). The notion that the Basin was the natural site of equilibrium for the city changed, dominant in the immediately previous decades (Vitz, 2018), and a broader vision became commonplace, even if it was not always articulated as such. This was centred on the necessity of appropriating distant waters, building large-scale infrastructures to do so. The Lerma Project is an example of such strategy. The need for this was compounded by the exponential growth of Mexico City, which went from 1,029,068 inhabitants in 1930, to 3,317,599 in 1950, 8,799,937 in 1970, and 15,047,685 in 1990 (INEGI, 2009). In 2017, its population, taking its metropolitan area in consideration, was 19,383,068 people (INEGI, 2017). Whilst demographic growth was indeed shaping engineers’ imaginaries at the time, the rate in which population increased was not fully comprehended as the Lerma was being built. Projections always fell short. Eduardo Molina stated that by 1989, only 3,000,000 people would live in Mexico City (Molina, 1939). Other experts, including those employed directly by the DDF³², similarly projected slower rates of population growth for the Mexican capital, which led them to overstate the reach and relevance of their designs and solutions.

³² AHA, Box 348, pp. 1-3

The rapid growth of city meant that water supply was not expanded as promised by the Lerma Project planners and promoters. Only two years after it was concluded, in 1951, an engineer stated that “despite these works, there is now in the Federal District, probably, more population without adequate drinking water service than that which was in this situation in the beginning of the [20th] Century” (Jiménez Lopez, 1953, p. 87). Presidential reports of the time also report on this situation (DDF; Secretaría de la Presidencia, 1976), and, by 1966, an expansion of the system was already on its way. Yet, this fact must not be read as a failure of the Lerma Project. Whilst its dreams of a fully supplied city were not reached, its role in producing a new set of socio-material relations between city, nature, and state through infrastructure cannot be understated. These new relations did not break with the foundational narrative of water necessity and threat, but rather reinforced it. Poor water management came to be seen as the source of the “fatal destiny of ruination” of the city (García-Quintero, 1951, p. 123).

Furthermore, the Lerma Project further fixed the prominent place of Mexico City in the process of country-wide modernisation. The capital carried on being the centre of political, economic, and social life for those experts in charge of supplying it with water. Its needs came before all others, and this position was not one of mere city-centred bias, but one that sprung from a professed desire of strengthening both the state and the nation. This was part of a broader historical tendency. The city came to be associated with the nation itself as the project of modernisation gained pace, after 1940-1946 (Sánchez-Mejorada, 2005; Vitz, 2018). If before policies designed to further land reform, increase rural irrigation, and develop the countryside were central to the tasks of the Mexican post-revolutionary state, after that decade its thrust became decidedly urban (Aboites Aguilar, 1998). This implied reconfiguring what water was, pointing out its potential utility for city and industrial life. It

also meant defining who could use it, and to which ends – a decision that underpinned the relevance of cities, pitted against countryside and nature.

This process required the production of an altogether modern water, made into a measurable input for urbanisation and industrialisation through various forms of technology and expertise. The Lerma Project, and the many experts working in it, were part of the making of these socio-material relations and processes, riddled with contradictions and gaps. By producing water as a natural resource, both technologically and legally, they furthered the reach of city and state to the Lerma hinterlands. The Lerma System subordinated the area to Mexico City's needs, and set the conditions for its industrialisation, as dispossessed peasants and fishermen became employed in the factories established in the area (Albores Zárate, 1995; Cirelli, 1997; Wester, 2009). At the same time, it provided water to the Mexican capital, in a time when its projected growth and industrial prowess were central to the concerns of engineers, bureaucrats, and politicians. Even if this water was not plentiful, as originally promised, it sustained the pace of urbanisation and allowed for urban life to be reproduced. Moreover, it became part of the production of nature, city, and state as intertwined processes and infrastructural configurations. This was certainly not only done through documents, archives, and scientific discussions. It was, and continues being, a decidedly socio-material process that is made, maintained and adapted through both labour and infrastructures.

CONCLUSION

In this chapter, I have shown how different forms of labour and expertise are crucial in understanding how the Lerma is made into an object of administration and knowledge. At the same time, I have also explored how its making, and the ways in which it produced a specific set of relations between city, nature, state and technology were shaped by diverse

forms of expertise and knowledge and their many contentions. In doing so, I have highlighted how everyday labour practices are central in making infrastructures stable as objects of knowledge, management, and control, and in enabling the transformation and appropriation of water through hydraulic infrastructures. I have also shown how these forms of expertise and labour are part of broader infrastructural imaginaries, shaped by notions of modernity, science, technology, history, statecraft, and the role of expertise. Whilst here I researched said imaginaries through an analysis of the Lerma in the archives, I want to conclude suggesting that these are still playing a role in present practices of archiving in the Lerma. The concern workers have with keeping files can be read as a claim on the value of their present labour that is rooted not only on the relevance analogous practices once had, but also on the discourses and narratives that shaped them and placed at the core of the task of state making through infrastructures.

However, the socio-material processes that the Lerma enabled matter beyond the question of archives and archiving. As I have shown here, the Project entailed a profound transformation of socio-environmental relations both in Lerma and in Mexico City. It did so as part of a longer history of environmental change through hydraulic infrastructure construction. By bringing the Lerma waters into the reach of the networked flows that sustain Mexico City, it enabled a series of socio-material transformations that are still shaping both the city and its hinterlands. Lerma is now an industrial area; heavily polluted and where hydraulic resources are rapidly depleting. Mexico City still relies on exploiting the aquifers beneath its ground, accelerating the process of soil subsidence that has characterised it for centuries (Novelo & Tapia, 2012), and requiring the appropriation of ever-more distant water sources. These materialities are crucial in understanding the present form of infrastructure, and how diverse labour practices are called upon to make them enduring, stable and to adapt them to ongoing socio-material change, often through

small-scale interventions. I now turn to these contemporary question, starting with an analysis of the Lerma infrastructures through the analytical lens of infrastructural aesthetics. Through it, I will highlight how the materialities of hydraulic infrastructures and the flows they sustain are central in the experience of inhabiting the city, and themselves enabled by numerous labour practices, entangled in various contentions and differential relations to the state, the city and urban water.

5. INFRASTRUCTURAL AESTHETICS

INTRODUCTION

At first, they were unremarkable. The hundreds of pale blue buildings and infrastructures that dot Mexico City and the Lerma area were just another part of a chaotic urban landscape. But as my fieldwork went along, these otherwise ordinary buildings started becoming unmissable. I would often spot them, perched on a distant hilltop, or hidden behind chain-linked fences on the side of the road. Some had been recently painted; others were in a state of decay. Finding myself unable to stop seeing the city as a dense mesh of diverse infrastructural networks, these different shades of pale blue paint became my way of understanding where SACMEX infrastructures were present. Pale blue is SACMEX institutional colour, at least for the time being. Every time a new Director General is appointed, the shade of blue changes slightly, alongside the SACMEX logo. Changes are never too radical. Blue remains, and so does Tláloc, the Mexica god of rainwater, who is now the System's official image. They are subtle enough to indicate that a new team is in charge, but similar enough to show that there is an underlying continuity in their labour.

This chapter analyses the Lerma infrastructures, their technical functions, and the diverse relations they bring together through the lenses of infrastructural aesthetics, moving from the archive to infrastructures themselves. The concept of infrastructural aesthetics refers to three interlinked processes. First, to the diverse modes of experience that infrastructure enables, which are outcomes of political, technical, and representational projects, processes, and practices (Larkin, 2018, p. 186). Second, to the material production of this aesthetic dimension through infrastructure, focusing on the role of labour therein. Third, to the material form of infrastructure, understood as a laboured site where modes of experience are enabled and lived through manifold interactions with infrastructure. The lens of

infrastructural aesthetics allows me to explore questions of state power, nature urbanisation and urban inequality as they unfold and shape space. At the same time, attention to the infrastructural aesthetics that result of informal modes of producing infrastructure allows permits an exploration of how state power and urban modernity are challenged, exceeded and resisted across Mexico City.

To explore these topics, I further develop the analytic of infrastructural aesthetics through the concept of aesthetic registers. These is a heuristic device that holds the experiential, productive and material dimensions of infrastructural aesthetics together, exploring how they come together in everyday interactions between infrastructures, materialities, and urban dwellers and workers. Here I focus on three aesthetic registers made up through the productive contradictions between visibility and invisibility; monumentality and mundanity; and formality and informality. I argue that an analysis of these registers, their fluid relations, and how they are produced, maintained, and challenged is a useful standpoint to analyse the making of state power, modernity, nature, and urban life through infrastructures. Infrastructural aesthetics are outcomes of diverse practices carried by workers, experts, urban dwellers, private companies, and other groups and individuals making claims on infrastructures, as well as by infrastructure's decay, ruination, and breakdown. This implies that aesthetic registers are not static but in flux. Ethnographic attention to these processes highlights this fluidity, its many contradictions, and the role of labour therein.

The concept of infrastructural aesthetics draws from Brian Larkin's work on the topic (2013; 2018). Larkin argues that infrastructures enable certain forms of experience through their material forms. This aesthetic dimension, he posits, is not posterior to the technical functions that infrastructure performs and allows. Instead, they are both constitutive of infrastructure as that which brings the world into being and produces the ways in which we experience said world (Rancière, 2013). The concept also draws on Olcese's and Savage's analysis of social

aesthetics (2015). Following their claim that infrastructures enable different aesthetic registers in everyday life, I question how infrastructures shape everyday life not only in relation to the political but also in terms of the making of social groups and the ways in which they inhabit space. However, here I take critical distance from both developments. Whilst still concerned with the question of experience, I also analyse the problem of production and reproduction. That is: how are infrastructures produced and maintained as aesthetic objects and relations? I argue that labour, expertise, and infrastructure's and nature's materiality are central in these processes. The question of production calls for a careful exploration of the practices that make infrastructure as an aesthetic dimension of everyday life, of unequal space production, and of the making of historical projects and processes.

To develop these arguments, here I analyse four infrastructures: the Lerma River Distribution Chamber; the Almoloya Pumping Plant; the Reforma well, and the Lerma aqueduct as it crosses the affluent Bosques de las Lomas area, in Mexico City. These sites, and the diverse aesthetics they enable and produce, can be explored through the heuristics of aesthetic registers. The first register is constituted by the opposition between monumentality and mundanity, is related to the functions that specific infrastructures have in relation to the production of power, in particular that of the state. Taking this classification into account, then the Distribution Chamber and the Almoloya plant can be characterised as *monumental infrastructures*. These were planned and designed both as functional infrastructures, and as sites in which the power of the state is overtly claimed through control over water, space, the city, and their entangled futures. The Reforma well and the aqueduct can then be conceptualised as *mundane infrastructures*. They are not the spectacular sites in which engineers, bureaucrats, artists, and politicians were affirming their powers – and the state's – over nature. Instead, they are often hidden from view, shaped by competing sets of claims

over their use, which challenge state power, and are indicative of the ways in which unplanned socio-material relations are made through networked infrastructures.

The second register is constituted by the interplay between technopolitical visibility and invisibility. This allows for an exploration of how infrastructures are entangled with the production and appropriation of nature and space. The main technical functions of the Almoloya Plant, a decidedly monumental site, were designed to be kept out of sight. These functions are central to the process of transforming water into a resource. As it has been abundantly argued before, the process of making water into a commodity requires that the process of material transformation is concealed, as water seems to be a liquid rooted in a set of local, historical, socio-material relations in order to become an abstract chemical compound, the product of human technical ingenuity (Kaika & Swyngedouw, 2000). The Almoloya plant is central in making nature into a modern substance, amenable to state control and commodification. Equally invisible are different spots in which the Lerma aqueduct crosses the Bosques de las Lomas neighbourhood. There, as infrastructure is kept out of the reach of the state by the Mexico City elite, the very modern order that Almoloya sought to produce is called into question. Far from being under the sole gaze and control of the state, the aqueduct is surveilled by the private security devices, both human and non-human, deployed by urban elites (Caldeira, 2000).

The final one is that which is structured around the opposition between formality and informality. Order and disorder are two imagined aesthetic orders associated with these two legal and political statuses, respectively. Formality, and those who benefit from it, are imagined as living in spaces of smooth, sleek, silent, and invisible infrastructural workings. In opposition, informal infrastructural development is often characterised as being highly visible, precarious, heterogeneous, noisy, and dirty. Whilst certainly this question exceeds the aesthetic dimension explored in this chapter, being related to political, economic, legal,

and environmental processes, I argue that the perspective developed here provides a unique point of view. In particular, it shows how what could be perceived as disorder from a normative standpoint, can also be read as the making of a different order. In the Lerma, and specifically in the Reforma Well, this is one which challenges narratives of state modernity and citizenship. Following recent scholarship (Roy, 2005; Ghertner, 2015; Moatasim, 2018), I also show how informality is part of the making of elite spaces. These, through a different set of interactions between informality and invisibility, also pose challenges to state power and control over nature and the city.

Ethnographic attention to infrastructures shows that their aesthetic registers are the outcomes of practices and disputes carried out through their own materiality. State experts and workers; urban dwellers both marginalised and wealthy; private companies that operate parts of the water grid, and those tapping into the grid informally, and often illegally, are all entangled in these struggles. They include not only contentions around urban life, nature, citizenship, identity, profit, and power. They also interact with infrastructural decay, ruination, and the wearing effect of water's flow. Following Rancière's (2013) conceptualisation of aesthetics, it can be said that infrastructures are the ways in which claims not only to see or speak, but to live, are made. These claims can be those that produce the state through the promises of modernity, nationhood, citizenship, and progress. But they can also be made through the situated practices of those that have remained outside the reach of these promises. In both cases, the aesthetic is central in understanding how the socio-material processes enabled through infrastructure are made and lived, and how they endure and change.

Moreover, these aesthetic registers are not intrinsic characteristics of any infrastructure, nor are they static or mutually excluding. Infrastructural aesthetics are constantly being made and maintained through diverse socio-material practices carried out by workers, urban

dwellers, governmental experts, and infrastructure's and nature's own materialities. Furthermore, the Lerma infrastructures are not homogenous spaces and processes but rather part of heterogeneous infrastructural configurations (Lawhon, et al., 2018). Visibility and invisibility, monumentality and mundanity, and formality and informality are simultaneously and conjointly produced and reproduced. The ways in which these relations intertwine and unfold shape historical processes as much as everyday experiences. Analysing the aesthetic production of infrastructure shows how modernity, citizenship, inequality, and nature are heterogeneous infrastructural relations and configurations. Far from being totalising processes, statecraft, commodification, and progress are fraught with contradictions that can be analysed through aesthetics as form, practice and experience. In their heterogeneity, infrastructural aesthetics show how social and political life is patchy yet made enduring, often through precarious material interventions. No contradictions are solved through infrastructure; they are playing out constantly, in multiple and open-ended ways.

The rest of the chapter is structured around the four aforementioned infrastructures. I start with the Almoloya Plant, where the discussion revolves around the questions of commodification and state modernity. There, the situated interventions of numerous workers upend both the purported invisibility of the process of resource making and the claims to modernity made through the Plant's infrastructures. I follow by analysing the Reforma well, where excluded urban dwellers make a mundane and visible claim on life through infrastructure in technopolitical, but also in aesthetic terms. Then, I turn to the aqueduct in Bosques, where the Lerma infrastructures are deliberately kept far from the sight and control of the state and its experts by Mexico City's wealthy elites. Both mundane and invisible, these spaces are constitutive of class and racial inequalities as lived experiences and as historical processes that shape urban space and life. Finally, I analyse the Distribution

Chamber, a monumental and highly visible infrastructure where experts, revolutionary artists, museum guides, and visitors produce, reproduce, and challenge the claims that the state has made on identity, progress, nationhood, and nature. Once a functional site and now a museum, the Chamber shines light on the temporalities embedded in infrastructural aesthetic production and experience, and complicates linear narratives by showing how memory and nostalgia shape the present as they transform the past and create future possibilities.

MODERNITY, STATE POWER, AND THE MAKING OF URBAN WATER

The Almoloya Pumping Plant is located at the southernmost point of the Lerma System, in the town of Almoloya del Río, where the Lerma River springs. In this site, infrastructures are implicated in the making of water into a natural resource, a process crucial not only for urbanisation but also for the production of state power. This making is certainly a technical process, in which water is captured, filtered, purified, chlorinated, and pumped towards Mexico City, its metropolitan areas, and many urban settlements in Lerma by SACMEX. Simultaneously, it is an aesthetic process, in which resource making and state power are shaped by the patterns of visibility and invisibility present there. These patterns are, as I argued before, not intrinsic characteristics of infrastructure but rather produced through situated practices. These are always political and material, and stem both from state-led political and technical projects, as well as from the ways in which experts and workers maintain and manage infrastructures. By exploring what is made visible or invisible how, and by whom, and how monumentality and mundanity are implicated and intertwined, I will analyse how state power, water as a natural resource, and modernity as a historical process are made through infrastructural aesthetics and its contentions.

The Pumping Plant itself is not immediately visible from the main road outside it. Located a few meters below the highway, in the margins of the Almoloya Marsh, it is only accessible through a small entrance that winds down a lush hillside. It was Moctezuma who took me and Cecilia, the geology student I mentioned in the previous chapter, there. As a response to my desire of knowing the Lerma System, he and his boss had drafted a list of places of interest that we should visit. When we arrived at Almoloya, *ingeniero* Ramírez was already waiting for us. He was the engineer in charge of this site, and he would be showing us around that day. The story he told us highlighted the role of the Plant in making water into a resource, and the way this implied the transformation of the Almoloya area. The site, he explained, is a complex, extensive facility, where the spring waters that used to flow to the Lerma River are now diverted, captured, and pumped to a filtration gallery, chlorinated, and then transported through a 60 km aqueduct to Mexico City. This is done through a series of networked infrastructures, all painted in SACMEX institutional blue, and fulfilling specific roles in transforming water into a natural resource.



FIGURE 14. THE AESTHETICS OF MONUMENTALITY IN LERMA. THE MANUAL ÁVILA CAMACHO CATCHMENT SYSTEM

The General Manuel Ávila Camacho catchment system (Figure 14) is named after the Mexican president that was in charge when the Lerma System construction began. The system captures water from the underlying springs through several underground galleries. These, in turn, are then connected to a series of pipes. Before being pumped to Mexico City, and the many communities in the Lerma area that are supplied through the System, these waters are mixed with others obtained from artesian wells dug in the vicinity. Once mixed, they are filtered in large tanks (Figure 15) to remove iron and manganese. One last step before pumping is chlorination; chlorine is added several times to the Lerma waters as it makes its way to domestic and industrial taps. Finally, after being transformed from underground waters to a potable one, this altogether modern water, a natural resource, is pumped through the Miguel Aleman Valdés Aqueduct, named after the president that was in charge when the System was concluded.



FIGURE 15. MAKING WATER PRODUCTION (IN)VISIBLE. PURIFICATION TANKS IN LERMA

Ramírez account of the way in which water is extracted, mixed, purified, and chemically transformed through infrastructures made visible what they purposefully conceal in their everyday operation. Beneath the catchment plant, the Lerma springs still flow, even if their output has decreased as a consequence of its continuous appropriation³³. The processes of

³³ In Almoloya, Lerma, and the surrounding areas, this implied a profound process of environmental transformation. After the first Lerma infrastructures were built, the Marshes quickly receded and disappeared. I found evidence of this in Moctezuma's archive; several photographs minutely describe this process in a period that starts in 1962. By 1966, some filtration galleries were drying up, and a plan to build 100 new wells was drafted, increasing supply by 5,000 l/s. Driven both by the exponential urbanisation of Mexico City, and the rapid environmental transformation in Lerma, the System started tapping into the underground aquifers. The situation today is dire, as the aquifer is overexploited (Maderey Rascón & Jiménez Román, 2001; Esteller & Díaz-Delgado, 2002; Wester, 2009).

filtration, purification and chlorination take place within sealed tanks in which water is nowhere to be seen. Rather, it is the pungent smell of chlorine what gives away the sites where this process takes place. At numerous stages of their material transformation into a natural resource, the Lerma waters are temporarily held in water deposits that distribute them to different tanks, pumps, and pipes. There, the presence of water is often only perceivable not through sight but rather through hearing. The sound of water flowing, sometimes rapidly, sometimes barely moving, is a common soundscape in the Lerma infrastructures. This is an infrastructural aesthetic experience mediated by senses other than sight.

Yet, the water that Ramírez made visible as he described the technical functions that these infrastructures perform was not this lively material. Rather, it was presented as an abstract substance, detached both from its potential functions in the Almoloya area and from its material characteristics, and relevant only insofar it could be quantified and used to supply urban areas, and in particular Mexico City. Made invisible, water could be abstracted not only materially (Richardson & Weszkalnys, 2014) but also aesthetically. Placed squarely in the arena of engineering and technology, water was merely an input to a logical, efficient, thoroughly planned system, in which pressures, gravity, chemical processes, and human ingenuity coalesce in the labour of urbanising water for Mexico City. Here again invisibility played a central role. The infrastructural processes that Ramírez made visible through speech were, in his narrative, functioning according to plan. If not fully automatized, they were close to that ideal, making water into a resource by detaching all traces of human action from

Along with the aquifer, the Marshes have almost disappeared. The few marshlands remaining are now unable to support the lacustrine mode of life that had existed there so far (Albores Zárate, 1995). The material, social, and economic relations that local fishermen, craftsmen, and farmers made through water were made marginal. Many became part of working class that was required to sustain the heavy industrialisation of the Lerma area. Some found work within SACMEX, a situation that still shapes workforce composition today, as I will explore in the following chapter.

them. Both nature and labour were made invisible in the task of making water into a potentially urban and commodifiable natural resource (Kaika & Swyngedouw, 2000; Swyngedouw, 2004)³⁴.

But visibility and invisibility are not fixed nor mutually exclusive. They are being constantly made and unmade by diverse practices and processes. Just as Ramírez presented a version of infrastructure in which invisibility and automatization allowed for the transformation of water into a resource both urban and commodifiable, others were challenging this aesthetic and technical claim. Inside the main deposit at the Almoloya Plant, the measuring of water levels within the main deposit is carried out using an ad-hoc intervention, a piece of patchwork³⁵: two bottles, half-filled with water, form a pulley that measures water levels that have been painted on a cracked wall (Figure 16). Here, far from the modernist accounts of a highly efficient, logical, and perfectly planned infrastructure, the little fixes that allow it to keep working become visible. These are never the object of representation inside engineers' offices or in the narratives they present when asked about how infrastructures work. Only appearing as the boundaries between visibility and invisibility are crossed, these fixes are central in sustaining processes of resource making and urbanisation in the Mexico City waterworks.

³⁴ These authors analyse the process of water urbanisation. That is: they are concerned with issues of power, difference, and hierarchy enacted through water distribution, and with the ecological imbalances that water appropriation produces. However, they are less concerned with the process of making water in a substance that can be made urban. This process is what I seek to make visible here.

³⁵ The concept of patchwork will be further developed in the next chapter. It refers to the localised practices workers and engineers carry out to repair and maintain water infrastructures using whatever materials are at hand. It emerges from a systematic lack of adequate materials, and is shaped by practical knowledge and improvisation. Patchwork is, I argue in this dissertation, what makes the Lerma System, its political ecology, and its promises of modernity and progress, precariously obdurate.



FIGURE 16. MUNDANE AND INVISIBLE: A PATCHWORK FIX IN LERMA

The question of state power and its production and reproduction is also at play in the infrastructural aesthetics at the Almoloya Plant. This is present in at least three interconnected ways: in infrastructures' materiality in relation to its surroundings; in the aesthetics of infrastructures' technological functions, and in the explicit relations made between these infrastructures and the figure of the Mexican presidency. The Almoloya Plant, hidden from view from the road that gives access to it, is unmissable if one is standing near the receding marshes. Concrete and metal buildings, pipes, valves, and pumps stand out against the reed, mud, and water that still exist there. They also contrast greatly with the self-built houses that constitute the bulk of the urbanised area in Almoloya and the

neighbouring towns. Their monumentality is not one that operates through ornament or art. Instead, it does so through the visible display of functional infrastructures, often painted in SACMEX institutional pale blue colour. The massive tanks that are used to filter and purify water; the valves and pumps that regulate and enable water's flow towards Mexico City, and the freshly-painted facades of warehouses, water deposits, and other buildings are productive of an infrastructural aesthetic that equates state power with technological progress, the conquest of nature, and the concrete and steel materialities of modernity (Gallo, 2005).

As in other monumental infrastructures, these highly visible aesthetic displays are central to their projected roles. This type of infrastructure, it has been argued, is not only central to the provision of services, goods, and resources, such as electricity, water, education, or health. When built and maintained on behalf of the state by workers and experts, they are being purposefully being inscribed in a "genealogy of the nation" (Rozenal, 2014, p. 334). They can be seen as testimonies of "the political and economic success of a regime" (Tenorio Trillo, 1996, p. 76) and also as "visible and lasting symbols of nation, progress, and modernity" (p. 77). In Almoloya, they are continuously producing an image and presence of the modern Mexican state, of the distant Mexico City, and of the socio-material relations that constitute them. Furthermore, this image and presence is not that of an abstract state, ruling impersonally over nature, space, and time. Quite the opposite. In Almoloya, the personalisation of state power is also being continuously upheld. This is visible in the presidential naming of both the catchment plant and the aqueduct. Nation, state, president, power, nature, infrastructure; all these objects, subjects, processes, and claims are being assembled in shifting configurations through infrastructural aesthetics.

The fact that both infrastructures have been named after the two Mexican presidents that oversaw the Lerma works show how infrastructural aesthetics mark the temporality of

power and progress, and of modernity and state-making³⁶. By naming crucial infrastructures after them, these presidents sought to create an identification between the individual figure of the president and the state, both united in the material provision of modernity through urbanised water. In Almoloya, then, modernity comes not as a result of the abstract power of the state but of the personal action of the president. This action is also visible in how capital flowed towards the Lerma works. In 1946, the last year of Ávila Camacho's administration, 49.7% of the budget during his six-year period – and 18% of the total cost was spent. 40.5% of the amount spent during Alemán's administration, and 25% of the total, corresponds the last year of the Lerma works (Departamento del Distrito Federal, 1951). The desires, aspirations, wills, and powers of these two presidents are inscribed into the making of the Mexican post-revolutionary state through infrastructural aesthetics.

It has been shown that, historically, state power is made through the appropriation, management, and production of the environment, including natural resources (Parenti, 2014; Moore, 2015). In this, infrastructures' technical functions are crucial (Swyngedouw, 2004; Swyngedouw, 2015) By looking at aesthetics, it can be argued that state power is made also through the ways in which infrastructures inscribe history, meaning, promises, and affects through their materiality (Harvey & Knox, 2015; Anand, Gupta, & Appel, 2018). However, this power is also being challenged by decay and breakdown; infrastructures are ruins in the making (Jaguaribe, 1999; Gupta, 2018). Here too the practices of repair and maintenance workers fend off this process of ongoing ruination. As in the case of resource making and commodification, the presence of otherwise invisible practices is what allows the materiality of infrastructures to endure, keeping with them the memories of rulers long gone and their promises of modernity and progress. Visibility and invisibility, both within

³⁶ The fact that every six years SACMEX institutional blue, and its logo, are modified as the Mexico City administration also changes are instances of this same process.

technical functions and within the monumental displays and mundane practices state power, are always shaping each other, in relations characterised by flux and change. Linear narratives of technological progress, nature appropriation, state making, and modernity are all challenged by this conflicting infrastructural aesthetics.

While the question of repair and maintenance practices will be fully explored in the following chapter, here I want to draw attention to just one of their elements. Central to the production of state power through infrastructural aesthetics as present and at work is the fact that these buildings and sites appear as well-kept and looked after. Not only is the power of the state made through the provision of resources and its production. It is also being upheld by its visible and material presence in the Lerma area. If turned into ruins, as indeed many other sites in the area are, their sway over how power is produced and experienced would be cast into doubt – or at least profoundly transformed. In those sites of ruination, not only rust has taken over. Pieces are being constantly stolen, and other claims over space are being made through the making of heterogeneous infrastructural configurations. This is not the case in Almoloya, where infrastructures are constantly maintained, even if it must be through situated, often improvised, patchwork solutions, such as the water bottle pulley I mentioned before. Practices made invisible can be fundamental in sustaining the visibility of infrastructure, thus enabling the production and experiencing of certain forms of power, and specific material discourses about time, progress, and change.

PRODUCING ALTERNATIVE SPACES OF RULE THROUGH HETEROGENEOUS INFRASTRUCTURAL CONFIGURATIONS

At *Colonia*³⁷ Reforma, next to the town of Santa María Tlalmimilolpan, there is a well that supplies the Lerma System. Located around 25 kilometres north of Almoloya del Río, the well taps the underground aquifer. The site is unremarkable. It is located on a back street, a few blocks away from the highway that connects the northern parts of the Lerma System to the Mexico City – Toluca highway. From the outside, it looks like any of the hundreds of wells in the region. Instead of the fresh coats of paint that characterise larger infrastructures in the System, here colour has been fading for a long time. The chain-link fences that guard the entrance are rusty, and there is no lock closing them firmly. Apart from the pump and the small building in which its controls are kept from rain, sun, dust, theft, and other potential breakdown risks, the other thing that stands out is a large laundry. Two rows of concrete sinks have been there for decades. As part of the 1966 agreement that saw the expansion of the Lerma System in face of rapid urbanisation in Mexico City and aquifer depletion in Lerma, several of these were built as part of a compensation package (Diario Oficial de la Federación, 1966).

No one was washing clothes there when we arrived, just after 9 am. There was only an elderly man walking out, moving two twenty litre water bottles (*garrafones*) with great difficulty. He walked past Moctezuma, Cecilia and I, but did not look at us. We walked in, and then I understood why Moctezuma wanted to take us there, despite the site not being in his officially approved list. Dozens of hoses were connected to each of the taps above the concrete sinks. Sharply they turned upwards, towards the electricity poles outside the well.

³⁷ Colonias are the names that different urbanisations receive across Mexico. They do not necessarily reflect a class distinction, as both middle-class and working-class neighbourhoods use this denomination. Wealthier residential areas can be called *fraccionamientos*, which often implies a particular form of spatial control, which I will discuss briefly in the following section.

Up there, they were almost indistinguishable from electricity lines. These ‘water wires’ (*cables de agua*), as Moctezuma called them, are an ad-hoc, localised solution to a systematic lack of good quality, sufficiently pressurised, and affordable piped water in *Colonia Reforma*. Following the wires with our eyes, we saw how they are connected to water tanks in the nearby houses and businesses. In silence, Cecilia and I explored the well, the sinks, and the water cables. We each took pictures; she used her phone, and I used the camera I carried around normally (Figure 17).



FIGURE 17. MUNDANE AND VISIBLE: ‘WATER WIRES’ AND THE AESTHETICS OF ALTERNATIVE SUPPLY

After a few minutes, we started talking again. We were both extremely curious as to how this system was put in place and why exactly was it built. We asked Moctezuma, who told us

that he only knew that it had been like this for many years – as long as he remembered. He also said that there was not any piped water in the area until very recently, and that coverage still was patchy and unreliable. Not satisfied with this explanation, we stepped outside. Cecilia encouraged me to walk around the area and ask people about the well and their water supply. I followed her to a nearby shop, selling cleaning products. Inside, there was a woman behind the counter. Worried about being displaced in my own ethnographic investigation, I asked away.

The woman said her name was Carmen, and she was not from around, so she did not know when the wires were installed. However, she said she thought that they had been set up as a response to the insufficient coverage and poor pressure that existed, and still does, in tapped water in *Colonia* Reforma. Recently, her shop had been connected to the networked grid, but water pressure and flow remained insufficient. Cecilia did not care much for my scholarly anxieties and started asking about her own concerns: water pollution. Carmen said it was indeed a problem. Piped water was dirty, had a bad odour, and was not good enough for drinking. The well, instead, provided them with fresh, clean, drinking water. Far superior, the well's water solved supply, pressure, and quality problems for them. This is why her shop, despite being connected to the grid, still relied partially on the water wires.

Further down the road, Antonio was working on a section of the sidewalk that had broken right in front of his garage. Behind him, his house rose above many of the surrounding buildings. *Colonia* Reforma is a self-built, informal settlement, which has been gradually accessing public infrastructures, such as electricity, roads, and water pipes. These pipes are not connected to the Reforma well, which Antonio said is used to supply Santa María Tlalmimilolpan, the much older, hilltop town, located a few hundred metres from where we were then. Instead, water comes from three water deposits, located uphill as well. Antonio echoed Carmen's arguments about water quality and pressure, and he further claimed that

their coverage was unequal, with many houses still disconnected from the grid. However, none of this explained why the water wires were built in the first place. For him, the problem was one of injustice, an argument I heard repeatedly in the many towns and communities that once had depended on the marshes. Unable to access water as the marshes had disappeared, the neighbours of what must have been a small rural hamlet then decided to connect themselves through these wires over 20 years ago.

This injustice had not diminished with time. As new pipes were being installed, connecting the houses that still were off grid, a new system of bill payment was also being rolled out. Before, houses connected both to the formal water network and to the water wires did not have to pay water fees. The latter, due to the non-formal characteristics of their connection; the former, as a result of the agreement signed in 1966 between the Mexico City and the state of Mexico governments, which waived fees for riparian communities in and around Lerma (Diario Oficial de la Federación, 1966). Antonio was livid. He said that the agreement was being breached, and that this was unacceptable. Moctezuma, who had been listening quietly to his tirade against SACMEX and Mexico City, finally spoke. He said that it was not them who were building the new pipes, but the municipality with permission of the CNA. It was them, he reassured Antonio, who were charging them for water usage.

But Antonio would not have it. He kept arguing passionately about the injustice at the root of it all: "This water was ours. They took it from us, and now they want us to pay for it", he said, incredulous. His mother had bathed in clear water for her whole life, he reminisced. Walking distance from the very house that was behind him there were the marshes, where she could access clean, fresh, free water. If one simply scratched the ground, plentiful water would spout. The Lerma System had forever changed this local political ecology. As the marshes disappeared, Antonio's family access to free, clean water was curtailed, and now they depended on the improvised water wires solution. More recently, even this

heterogeneous configuration was being called into question, as formal water supply was being unwelcomingly extended, bringing Antonio, Carmen, and their neighbours into a new set of political ecological relations with the state and nature.

Through situated interventions, like these water wires, otherwise disconnected households and neighbourhoods enter in a relationship with the formal, state-owned and operated water supply network. This suggests that there is not necessarily a radical opposition between the formal grid and informal ways of acquiring water supply. What exists is a heterogeneous configuration (Lawhon, Nilsson, Silver, Ernstson, & Lwasa, 2018) in which both infrastructural relations coexist. Through emergent, creative, and improvisational practices, otherwise excluded households and neighbourhoods secure water supply. Despite contravening the designs and ideal orders of the networked piped grid, these alternative configurations are not being actively shut down by the government. On the contrary: they are known by its workers, and oftentimes even admired for their ingenuity, like the case of the Reforma well indicates. In Mexico City, numerous instances of said heterogeneity exist³⁸. The case of water tankers, or *pipas*, is well researched (Aguilar & López, 2009; Gómez Valdez, 2015). These can be either public or private and are part of broader configurations which include purchasing bottled water, public and private water wells, amongst other

³⁸ Formal piped water coverage in the state of Mexico and Mexico City is high. According to 2013 data from the National Institute of Geography and Statistics (INEGI), 88.91% and 97.48% of households, respectively, have a nominally functional piped intake in their premises. However, these numbers might hide the complex realities of water access on the ground. The case of the Reforma well is both unique and commonplace. It is singular insofar the strategies deployed by neighbours to secure water supply are framed by the situated materialities of water availability. Using the pressure (Anand, 2011) that the well provides, the Colonia Reforma inhabitants devised an efficient system, which is engaged in a non-binary relation with the formal grid. This is both due to the fact that it depends on the well, which is maintained and operated by SACMEX, and that it coexists with formal piped water supply. Yet, in Mexico City, many of the houses that use water tankers in a regular basis are also connected to the grid, whether it is due to insufficient pressure, gaps in service, or poor water quality (Gómez Valdez, 2015; de Alba, 2017). The high percentages of formal water coverage hide these heterogeneous configurations, presenting an image of an extensive public service, which is not necessarily a lived reality in Mexico City and its hinterlands (Schwarz, 2017).

infrastructures. It is through these alternative orders that precarious water supply is achieved.

These heterogeneous configurations complicate narratives of modernity and modern state power formation through the provision of water supply. This is not a case in which privatisation splinters modern infrastructural orders (Graham & Marvin, 2001). Nor is it the case that the retreat of the state, and the end of the ideals of public service provision for all, create spaces for challenging state modernity³⁹. Instead, the Reforma well indicates that these challenges might be always already present in the processes of state formation and urbanisation, at least in Mexico City and its hinterlands. There, the situated interventions by generations of settlers and neighbours created an order that differs from ideals of piped water provision, but nevertheless fulfils the need of continuous supply, and allows the use of eminently modern tools, such as washing machines, showers, and toilets. These “alternative spaces of rule” (Meehan, 2014, p. 222) are not chronologically nor logically posterior to formal, piped water supply. They are simultaneous, and often previous, and therefore constitute themselves not merely as challenges to an already achieved state modernity, but as processes that call for a reconsideration of what modernity and the state are in Mexico City and its hinterlands.

³⁹ De Alba (2017) shows how the practices of informal water supply in Mexico City are not necessarily opposed to the state but engaging with it through diverse forms of mediation. These constitute what he calls “differently modern practices” (2017, p. 183). In Mexico City, these include the participation of technical intermediaries (informal tanker operators, truck drivers), political intermediaries (neighbourhood leaders, local politicians), ideological intermediaries (who use the promise of better water supply to mobilise city districts for particular events, such as elections or protests), legitimating intermediaries (who justify state inaction framing it as a result of unforeseeable threat and emergencies), and representative intermediaries (who represent their communities, often against the state).

De Alba argues that the work of these intermediaries shows how the state “no longer plays a monopolizing role” (2017, p. 191) in water supply. He further argues that “Informality gave the state a multiple and weakened face, thus cracking its modernist façade.” (Ibid.) In this dissertation, I argue that modernity itself is riddled with multiplicity and difference, and that said façade is often a technopolitical and aesthetic device deployed *ex post*, in order to grant stability and solidity to what remains plural in the ground. This leads to consider the state not as a previously solid entity that has become cracked just recently, but as a set of processes and practices that are always already multiple and conflicting.

The Reforma water wires, and certainly other heterogeneous infrastructural configurations, show how state power is porous, and constantly upended through everyday practices. This porosity is constitutive of state power itself, and not merely a deviation from a historical trend. The Reforma well is where the material presence of the state ends, and where the possibilities of an alternative configuration are being built. This particular configuration is highly localised, as the ideal version of public piped supply is present simultaneously in Santa Maria Tlalmimilolpan. As water pipes expand the logic of centralised control to *Colonia Reforma*, the modern ideal is not received with glee. Rather, it is seen as an encroachment on a previously stabilised infrastructural configuration, which had thus far allowed neighbours to access water without entering a contractual relation with the municipality and its water utility. In this case, the contract is seen as a further moment of injustice, as previously appropriated water is now sold to them, destroying the alternative space of rule that provided a minimum sense of autonomy. Yet, as Antonio's continuous reliance on the water wires indicates, this change will not go uncontested.

Furthermore, the messy aesthetics of mundane infrastructures show how the relations between lack and supply, connection and disconnection, and formality and informality are heterogeneous and being constantly made and challenged. Far from the modern universalist ideals of piped water supply, in which lack and presence are solely determined by the state, the Reforma well water wires show that alternative forms of achieving connection are possible. In these, not only the question of water supply is at play. As indicated before, the production of power, on equally heterogeneous ways, is visible. Without being exclusionary others, formal and informal connections are shifting poles in the relational making of urbanised water, its pricing and valuation, histories of dispossession and appropriation, citizenship, and the state. Modernity here appears not as a linear process that drives history forward, to a space of uniform connection and homogeneity. Instead, heterogeneous

configurations show how some of the ideals of high-quality water, health, sanitation, and hygiene, constitutive of modern citizens, can be produced through a more fluid relationship with the state and its public utilities. These should not be romanticised as instances of freedom, but neither should they be discarded as mere deviations from a norm that is morally and materially unescapable.

The wires offer other opportunities to analyse how modernity is contested as regime of urban production. By inscribing a different order into the landscape, they provide an aesthetic counterpoint to the imagined sleekness of the Lerma System, whether monumental or mundane. Instead of the invisibility of quotidian water infrastructures, key to the making of water into a commodified resource (Kaika & Swyngedouw, 2000), here we have a highly visible configuration that puts this commodification in question, whilst also challenging the monumental visibilities of the infrastructural state. Antonio's clarity of how the Lerma had dispossessed them from their free access to water, or Carmen's dismissal of networked water's inferior quality, show how the localised relations that the Lerma infrastructure sought to destruct persist, even if transformed. While it might be the case that the lacustrine environment is mostly gone, and so is the political ecology that was organised around it, this does not mean that the Lerma inhabitants have entered a relation of simple dependency or abjection in relation to the state and its infrastructures. By achieving alternative forms of water supply, they reinstate the relevance of water's locality: purity, cleanliness, and memory flow in the Reforma water wires. What could be easily dismissed as a deviation from the ideal norms of urban hygiene and order, reveals the active production of another configuration, and of a different set of power relations.

THE POROSITY OF STATE POWER

Heterogeneous configurations are not simply a mark of those that are left out from the ideal orders of infrastructure, and from its promises of efficient, continuous, and reliable water supply. Heterogeneity can become a different kind of challenge to the promises of state power and modernity when characterising not the alternative configurations that the otherwise disconnected deploy to secure water supply. In the upscale neighbourhood of Bosques de las Lomas, in west Mexico City, the stakes are different. There it is not the case that highly visible interventions reveal the creativity of disenfranchised local communities, and the porosity of state power and modernity. Instead, it is the invisibility and inaccessibility of water infrastructures what shows the limits of the state, both as a set of processes and practices, and as a concept deployed to understand how socio-material relations are governed and produced. In Las Lomas, SACMEX workers and engineers found different obstacles in their attempts to survey infrastructures, control leaks, and repair diverse breakdowns. This section focuses on them to reveal another side of the contentious making of state and power through infrastructures.

Bosques de las Lomas (or Bosques from hereon) is a wealthy *fraccionamiento* located west of the more established Lomas de Chapultepec⁴⁰ neighbourhood. It was built between 1970

⁴⁰ Lomas de Chapultepec was developed between 1921 and 1930, under the name of 'Chapultepec Heights'. It was part of the post-revolutionary expansion of Mexico City, and was embedded in a broader planning moment that had as its goal the modernisation of the Mexican capital (Carrillo Barradas, 2004). The plan included the construction and retrofitting of numerous roads in the city, as well as an increase in water supply, the expansion of water sewage, and of electricity and sanitation services (Contreras, 1933). Chapultepec Heights was designed as a garden city, to be built on the lands of the Chapultepec Forest. As other garden cities, it had health, sanitation, and public life ideals imprinted in its very layout. Streets were designed to facilitate the constant flow of cars; land plots were large enough to support big gardens and detached houses, and green areas were plentiful, to ensure clean air. The houses themselves have been deemed as productive of a certain kind of modernity and citizen: modelled after the 'new colonial' style of California, they are said to represent the aspirations of the "new emergent bourgeoisie after the Mexican Revolution" (Winfield & Martí, 2013). Green spaces, automobile mobility, and fully serviced homes that allowed for a clear separation of private and public life are some of the material characteristics of these aspirations.

and 1982, on the lands of the former communal lands⁴¹ of Lomas del Chamizal (Hinojosa, 1982; Calderón Cockburn, 1987). The process of developing Bosques was riddled with irregularities. On numerous occasions, the neighbours of Lomas del Chamizal denounced the aggressive tactics that developers behind Bosques were using to dispossess them from their lands. Journalistic accounts from the time (Correa, 1982; Hinojosa, 1982) tell a story of intimidation, corruption, and collusion between judges, developers, and politicians (including the then incumbent Mexican President). Neighbours were not only denouncing this process of forceful appropriation. At the same time, they were claiming that the space that was being built for the wealthy elites close to the Mexican government of the time had better public works than their own neighbourhoods. Whilst they were struggling to get water pipes built, they denounced that, in Bosques, mains over 20 inches wide were being laid out on a regular basis.

This infrastructural inequality is still relevant today. Both Bosques and Lomas de Chapultepec have plentiful water. In 2007, daily consumption per capita in Lomas was placed between 800 to 1,000 litres per day. In some neighbourhoods in water-scarce Iztapalapa, in eastern Mexico City, per capita consumption was around 28 litres per day then, whilst the city-wide average was 365 (Aguilar J. A., 2007). In 2018, average consumption city-wide was 366 litres, and the average in Iztapalapa was placed between 50 and 100 litres (Capilla Vilchis, 2018). In the informal settlements near Bosques de las Lomas, which I also observed during my fieldwork, water supply is intermittent, and many houses are not connected to the network. Abundance of water in Bosques and Lomas is compounded by the location of both neighbourhoods. The hillside in which they were built is where the main Lerma aqueduct passes by. Both neighbourhoods benefit from their upstream position, the existence of wide

⁴¹ This encroachment of private development over communal lands was common across the city, as 48% of its expansion between 1940 and 1975 involved this type of property (Calderón Cockburn, 1987, p. 302).

pipes, and the power of gravity in conducting water to the reservoirs and mains that supply the area. Engineers and workers often remarked how the very layout of the water grid was indicative not only of a more thorough process of planning, but of the wealth that characterises this area of western Mexico City.

This most certainly does not mean that Bosques is exempt from breakdowns on water supply. One early spring evening, I followed a group of workers, engineers, and bureaucrats as they tried to find the exact location of a potential leak that was diminishing water pressure there. *Ingeniero* Obregón, who held a senior position in the local office, was in charge. Over the course of a few days, his team had been surveying the area, trying to pinpoint the problem that was leading to a deluge of calls from Bosques neighbours. As a telling sign of their clout with city authorities, that day around 15 people, both from the city and the borough government, were exploring the area. Amongst them, it was the team I was working with that day. We had travelled across the city, being called off another job, to come aid in this situation. The many difficulties that these work teams found when carrying out this survey, and when trying to repair the problem, are telling of the ways in which Bosques challenged not only the property rights of communal landowners, but also the production and reproduction of state power through infrastructures.

After making sure the local water deposit was functioning correctly, Obregón assembled the men in the median strip of Bosques de la Reforma, one of the main roads in the *fraccionamiento*. He asked one of his aides for a plan of the area (Figure 18). When he unrolled it, I could see that it had yellowed and had stain marks in the edges. He began describing the grid: he pointed at the 2 large 32-inch water mains, to the smaller 10 and 6 inch that branch out from it and mentioned that there were many smaller ones that were not visible there. He then proceeded to explain how water should be flowing, and to logically deduce where the problem might be. Chokepoints and sudden changes in pressure due to

different pipe widths were some of the leads he was mentioning. Following the plan on foot, we began surveying the area.



FIGURE 18. MAKING INFRASTRUCTURES VISIBLE THROUGH REPRESENTATIONAL TOOLS.

Our first stop was a small cul-de-sac, off the main street. The street was not open to transit; a large metal door blocked it across the entrance. A senior engineer and a worker, whose names I did not catch, walked towards the door. A private security guard met them there, and asked for their ID. The engineer seemed a bit surprised, but he did not oppose. He took out his wallet and gave the guard the requested document. The worker followed him, and they went in. Whilst we waited outside, some of the other workers started telling me that this was not the first time they were there. A few months before, there had been a leak in a

six-inch pipe in the area. They tried to find it for a couple of weeks, drilling the street at different points for several days in a row. The leak was elusive, and the neighbours started complaining more forcefully. Over time, there were less and less options left. Finally, only one site was possible: the leak was inside one of the nearby houses. Its owners refused to let them in at first. They were wary of the workers' intentions. It was not until they took the time to explain the pipe layout to them that they understood that indeed the pipe was in their backyard, and that if they did not let the workers in, their problem would not be solved.

A group of engineers overheard the conversation and decided to intervene. They told me that this problem was not exclusive to six-inch pipes, or to that street in particular. These engineers were certain that a 32-inch water main was underneath a row of houses nearby. I asked, naively, if this was not against current regulations – by law, right of way for aqueducts is 20 metres to each side. Obregón, who was listening to the conversation, grinned at me, quizzically. He told me that the whole area was invaded (*invadida*), a word that stands for the illegal occupation of public lands by private actors. Marginalised informal settlements are often referred as invasions (*invasiones*). To use this word in a wealthy neighbourhood was something that caught me off guard. With this remark, Obregón was explicitly drawing a parallel between the many popular *colonias* that exist in the ravines of west Mexico City, and this most wealthy neighbourhood of Bosques de las Lomas. In both cases, the ideal legal order that supposedly rules over water infrastructures was upended by the informal production of space.

Plentiful attention has been placed at the infrastructural practices of marginalised populations in informal settlements (von Schnitzler, 2008; Anand, 2011; de Alba, 2017). Recently, these insights have been expanded to include those that take place at the other side of the spectrum, analysing how elite informality is central in urban development (Roy, 2005; Ghertner, 2015). The journalistic investigations mentioned before shed light on the

various tools that elite developers, neighbours, and politicians deployed to develop Bosques. These resonate with processes of 'elite informality' occurring elsewhere in the Global South (Moatasim, 2018). In the particular case of Mexico City, it has been long argued that metropolitan expansion has taken place through the encroachment of former *ejido* land (communal property), both by the urban poor and the urban elites (Calderón Cockburn, 1987; Jones & Ward, 1998). In these studies, emphasis is placed on the ways in which elites upend rules regarding development, property regimes, and infrastructural provision. Whilst this seems indeed to be the case in Bosques, the everyday technopolitics of infrastructure also point to a different dimension of elite informality: the way in which it challenges modern infrastructural ideals of publicness, (in)visibility, and management.

Obregón's wry comment on Bosques as an invasion, which put commonplace perceptions of informality on their head, can become a window to understand the heterogeneous spatio-temporalities of informality. Whilst legal documents that regularised land ownership had long been obtained, and service provision had been formalised from the onset, elite encroachment on public infrastructures has a longer and sturdier material endurance. The legal character of property above ground does not mirror the complex infrastructural arrangements that make up urban life below it. In the underbelly of the city there is a sedimentation of public and private modes of developing space, which can enter in conflict when breakdowns occur. Elite self-segregation from urban life, a process which fragments modern ideals of publicness and openness in the city (Caldeira, 2000), also poses challenges for urban service provision through infrastructures. This has been theorised as an urban splintering, in which private logics of space production and management upend public orders and flows in the city (Graham & Marvin, 2001).

Nevertheless, Bosques poses a challenge to splintering as a concept. This elite space is not a hermetically sealed enclave (Graham and Marvin, 2001, p. 222). Rather, it functions as a

porous interface, both above and below ground. In the latter, the case is clear. Despite elite control of streets, sidewalks, entrances and exits through securitisation, water still flows from Lerma towards downtown Mexico City. The fantasy of seclusion is being constantly washed away by the water that makes its way not only in the Lerma aqueduct, but in the publicly serviced taps that keep Bosques alive. This process remains below ground, almost invisible, if it were not for the constant breakdowns in water supply. It is then when the infrastructural flows that make up urban living become visible, tangible, and contentious. Despite the many efforts to keep workers and engineers at bay, more often than not these elite enclaves are forced to let them in, and to work in what is now their private property. They do so not out of solidarity with Mexico City at large, but as a self-evident response to the risk of losing water supply on their own houses.

This porosity, as the gated entrance to Bosque de Cacaos shows, is heavily policed by the security logics of the Mexican elite and its aesthetics. Against the threat of the other, these gated streets are protected by deploying bodies and metal as a physical barrier. These borders, moreover, enact other forms of difference and segregation. After discarding Bosque de Cacaos as the leak site, I walked with the work team I was accompanying that day back to their truck. We jumped on the box and drove uphill to the place where the first complaint had originated. We got off and started walking again, looking for several of the houses that had called SACMEX to report water shortages and low pressure. We rang on a number of bells, but no one opened. We kept walking, and spotted an elderly man, accompanied by a person who seemed to be his driver, and a slightly younger man, coming out of a nearby mansion. The workers approached them and asked them if they could come inside to check water pressure. They wanted to know if the issue was still going on, and how bad the situation was. Their request was met with bewildered looks and outright animosity. The

elderly man was adamant: they could not go in unless they produced official IDs and called their boss to explain the situation.

The workers tried to argue their way out of the situation, as Obregón, their boss, was busy elsewhere, and did not have to make his way up for such a simple task as opening a tap. This kept going for a few minutes. The driver kept quiet and the younger man joined his companion's demands. After pondering if I should intervene, I decided to do so. I told the men that we were looking for the solution to their water problems. They asked if I was a SACMEX engineer or officer. I said that I was just a researcher, but that I had been working with these workers for months now, and that we were there as a response to their complaints. My intervention disrupted the discussion. Both men looked at me and changed their stance. They said that the men could go in, and that they were sorry for their wariness, but that I surely understood their position. Given the state of insecurity, they could not just trust *'anyone'* to go in their houses. The neighbours' reference to my understanding of their distrust reveals the way in which my speech register distinguished me from the SACMEX workers. Surely, as a member of the Mexican middle class, and a doctoral researcher, I could see how they could just not let a group of unknown men inside their house, even if they were there on behalf of the Mexico City government, and as a response to their demands.

This event was not extraordinary, the workers then confided in with me. It was common for many inhabitants of Mexico City's elite *colonias* and *fraccionamientos* to distrust them. Often something as simple as checking how a tap is operating implied processes of negotiation crossed by embodied practices and experiences of racial and class inequality. My presence there had changed the dynamic, making completely visible processes that otherwise are relegated to the invisible sphere of everyday interactions between state workers and urban elites. This suggests that wealthy enclaves are porous, and differently navigated according to one's positionality. Class, and indeed race, can be performative tools that open the gates

of these elite spaces. Moreover, this suggests that the state is too enacted in the everyday interactions that surround the socio-material lives of infrastructure. Instead of being a homogenous entity, which rules over space and water through laws, regulations, and infrastructures, it is a heterogeneous process that is shaped by the actions and inactions of engineers, workers, and bureaucrats. This moment also shows how the state has a distinct temporality (Ghertner, 2017), which emerges with clarity in moments of infrastructural breakdown.

Finally, the process of repairing a leak in Bosques de las Lomas challenges dominant notions about the power of the state in relation to water supply. Whilst it has long been acknowledged that privatisation has weakened state control over the provision of this service, these arguments often refer to the participation of private companies in water supply and management (Martínez Omaña, 2002). Here, there is another kind of privatisation taking place, one that is related to the dynamics of elite informality, both in history and in its everyday practices. These processes show how state control over water is not hegemonic, nor completely diminished. Instead, it exists through a porous and patchy set of practices that selectively make visible or invisible certain infrastructures, labour practices, and various class, racial, and spatial inequalities. This heterogeneous infrastructural configuration is a useful standpoint to problematise how the city is made and maintained. But it also offers a standpoint to analyse how the making of the state through water supply and management differs from both established scholarship in the topic, and from the narratives that bureaucrats, intellectuals, and artists have crafted regarding the Mexican state. The Mexican post-revolution not as a moment of increasing social justice or total state control, but of deepening and enduring socio-spatial inequality and of splintered rule over space and nature.

AESTHETICS, NOSTALGIA, AND THE DREAM OF A SOCIAL JUST FUTURE

NOW PAST

There is a sculpture outside the Distribution Chamber where the Lerma System ends. It is a monumental image of Tláloc, the Mexica god of rainwater, made of mosaic. Two dates are inscribed on his feet, as he leaps forward. On his back foot, the year is nine-cane. On the front one, it is four-cane (Vázquez Martín, 2012, p. 114). In the modern calendar, they correspond to 1942 and 1951. The monumental sculpture is the work of Mexican artist Diego Rivera, built to commemorate the conclusion of the Lerma Water System, precisely in 1951. The sculpture is part of a larger complex, which includes a distribution chamber (*cárcamo*), and bears the name of the Lerma River, built by communist architect Ricardo Rivas and Diego Rivera. It is here where the monumentality of the Lerma infrastructures is at its most visible. The relations between infrastructure, water, the state, and power are not hidden beneath the ground, or behind closed gates. Neither are they materialised in invisible and marginalised infrastructural configurations. Instead, they are the explicit subject of a range of material interventions with a clear political message.

Inside the distribution chamber, its four walls are covered by the Rivera mural, titled “Water: Origin of Life in Earth”. The west wall shows water overflowing from Tláloc’s hands, above the tunnel that connects the distribution chamber to the rest of the Lerma infrastructures. The liquid flows to both sides, where it is collected by two groups of two workers – one at each side. Using their helmets, they are giving water to Mexico City’s thirsty inhabitants. To the left, the upper classes are represented through a pious woman, dressed conservatively, and wearing a Catholic cross necklace, and a little kid with a pet monkey, a symbol of conspicuous consumption. To the right, a working-class family, who perhaps had just migrated from the countryside, are also receiving water. Behind both groups, a dry city can be seen, its buildings progressively changing from a pre-Columbine past to a modern future.

Opposite these depictions of a dry city, both the agricultural and leisurely uses of water are represented through an orchard and a child – Rivera’s daughter Ruth – swimming. This is the promise of the Lerma waters: a future of abundance in which water would satisfy both needs and wants for everyone.



FIGURE 19. MONUMENTALITY AND VISIBILITY IN THE LERMA WATER DEPOSIT. THE ORIGIN OF LIFE AND WATER PROVISION AS SOCIAL JUSTICE IN DIEGO RIVERA'S MURAL

The chamber floor represents Oparin’s theory of the origin of life⁴². An electric spark transforms chemical compounds into biological forms, unleashing the process of evolution. From the most basic cells, increasingly complex organisms are born, culminating in the human species. Rivera painted a ‘mongoloid’ woman (Figure 19) and a ‘negroid’ man (Figure 20) in the north and south walls, respectively. In his reading, these two ‘races’ represented

⁴² The theory was in accordance to dialectical materialism, as an official interpretation of Marxism held by the Communist Party of the Soviet Union (Schopf, 2001, p. 121). Rivera himself was once a member of the Mexican Communist Party, later expelled due to his Trotskyist leanings.

the origins of humankind, as life would have originated in the polar caps in the form two different human groups, who would have migrated towards the equator as weather changed. In this reading, white (or 'aryan', in Rivera's own writing) people would be the result of miscegenation, themselves "the result of a degenerative process of the two original types of humans." (Rivera, cited in Vargas Parra, 2012, p.75) Rivera further argued that this so-called 'degeneration' was no other than the superhuman of Gobineau, Goebbels, and Hitler (1952). Whilst the ramifications of this affirmation are worthy of critical exploration in themselves, this far exceeds the purposes of this chapter. Suffice to say that, as a political statement, Rivera was combating, in his own way, the white supremacist narratives of his own time, privileging a view that made of miscegenation, or *mestizaje*, the natural condition of humanity – and a cornerstone of the Mexican state's racial project (Doremus, 2001).



FIGURE 20. MAKING RACIAL POLITICS VISIBLE. THE ORIGIN OF LIFE, MANKIND AND THE LIFE-GIVING CAPACITIES OF WATER
IN DIEGO RIVERA'S MURAL

Opposite Tláloc, the engineers, architects and topographers that designed the project are depicted, in a scene that resembles Da Vinci's Last Supper (Figure 21). On the leftmost side, Ricardo Rivas, the architect that built the Distribution Chamber holds a plan in his hands. In the centre stands Eduardo Molina, Chief Engineer of the Lerma Project. He holds open a chart representing the aqueduct's altitudinal plane. Many more engineers and experts stand next to them. Below these men are the four red water gates that led to the four deposits in Chapultepec, built as part of the Xochimilco water supply project (Perló Cohen, 1989; Banister & Widdifield, 2016). In between them, the chemical formulas of ammoniac and chlorine, used to disinfect water, are represented. Looking towards Tláloc's hands, his monumental head, part of the fountain outside the chamber, can be seen. This is the god made man, delivering water to the city through the labour of workers, his modern aides. Invisible from that position are the pipes and valves, painted on the inside of the tunnel that connects the chamber to the Lerma. Here, the mural is representing water supply, and quenching of the historical thirst of Mexico City, as the result the productive relations between human labour, science and technology, infrastructure, and nature as god.



FIGURE 21. MODERNITY, SCIENCE, TECHNOLOGY AND THE TASK OF SUPPLYING WATER TO MEXICO CITY. A MONUMENTAL CELEBRATION AT THE RIVER LERMA WATER DEPOSIT

The *cárcamo* building, its mural, and the fountain had the ambitious goal of working together, as a materialisation of the practice called ‘plastic integration’ (Noelle, 2001) or ‘unitary plastic’ (Alfaro Siqueiros, 1948)⁴³. This is the notion that architecture, painting,

⁴³ David Alfaro Siqueiros, one of the main figures in the Mexican muralist movement of the first half of the 20th Century, reflected on the significance of unitary plastic (1948). His main argument was that this movement was distinct to other modern approaches to art insofar it had a functional political goal. At the beginning, he claimed, the aestheticist remnants of its promoters led them to paint in old colonial buildings, or to do so in new buildings that were not designed to be complemented by muralist interventions. Still conceptualising plastic arts as autonomous realms, these murals did not advance Siqueiros vision of a future functionalist, integrated art. Instead, that advanced an individualist, liberal logic, which stood against the goals of the new society the movement was advancing. This was a collectivist one; a future of socialism and democracy. Plastic arts, as an integral practice, had a pedagogic, psychologic, and political function. To do so it had not only to move forward the ideals of a socialist future, but it had to integrate the technologies and materials that would make up this future: concrete, steel, plastics, chemicals.

Certainly, not all depictions of the future were built around technological advances and the power of metal and plastics. As such, the goal of plastic integration varied greatly, as a review (1949-1953) of the magazine *Espacios*, edited by the muralist community in Mexico, shows. Diego Rivera is one of such cases. Whilst he certainly imagined a future of social equality under socialism, his version of it relied much more on the use of traditional materials, many of which had fallen in disuse for centuries. His work is often an attempt to arrive at a different modernity through a reinterpretation of Mexico’s pre-Columbian heritages. In the case of the Fountain, this is shown in the use of mosaics (Vargas Parra, 2012). Whilst in the mural inside the *Cárcamo* the material used was plastic paint, he later mentioned regretting his decision.

sculpture, and social and political discourses could work together in the built space, using local materials and inspired in historically rooted practices of construction and art production. Rivera himself talked at length about this, calling the *cárcamo* project “the most interesting working problem I had ever encountered in my life”, being carried out in a building “of a completely social and popular function” (Rivera, 1952). In that regard, the goal of the Lerma River Distribution Chamber was both to operate as a hydraulic infrastructure, but also to fulfil a political and pedagogic role. Briefly, its discourse can be summarised as follows: it is a promise of a future of plentiful water, in which nature, as a godly gift and through the agencies of labour and infrastructure, would be available to all social classes inhabiting Mexico City. Materially, the distribution chamber is an infrastructure that seeks to materialise the social justice futures envisioned by the Mexican post-revolutionary governments, and to enable an experience of it through aesthetic means.

I first learnt the basics of this interpretation not through reading either Rivera’s written work on the matter (Rivera, 1952), nor through the analyses that have been printed more recently (Noelle, 2001; Vargas Parra, 2012)⁴⁴. I heard it several times, over the course of six months, from Antonio, a museum guide and functionary in the Mexico City Government, and by several young guides that worked under his supervision. Antonio had been working for the Ministry of Environmental Affairs, which administers the site, for over 15 years. He had seen the chamber lay empty; its walls boarded up until restoration of the mural started in 1991. For ten years the experts at Mexico’s National Institute for Fine Arts (INBA) intermittently restored the murals, nearly destroyed by the corroding effects of chlorinated water, and by the apparent unsuitability of the polystyrene paint that Rivera used in 1951⁴⁵. Since 2011,

⁴⁴ Although I do rely heavily on these interpretations in the previous paragraphs, as well as in my fieldnotes.

⁴⁵ Reports mention that the mural started deteriorating quickly after its inauguration. It seems like, by 1956, it was already covered in mould and oxide. Sometime after, the waters were diverted temporarily, and a coat of

when the museum opened its gates, he had been closely involved not only in administering the site, but also in training its guides, as well as serving as its most senior one. I heard him explain the murals to walk-in visitors and organised tours several times, always delivering the story with eloquence and clarity. He told me he had learnt this story from the restorers that had been working there before the museum opened.

In Antonio's voice, the mural was brought to life as a two-layered set of meanings and materials. The first involved Antonio repeating an official narrative, similar to the one I reproduced here, every time he guided people through the museum. He normally followed the same order, starting with the east wall, then talking about the floor, to then make his way to the north and south ones, and concluding with a spectacular view of the west: Tláloc's hands giving the sacred gift of water to the city, and his human face, in the fountain, above them. The narrative replicated the official readings not only of the mural but of certain characteristics of the Mexican post-revolutionary project. It continued to affirm the mestizo as the ideal racial and political subject. It still depicted the state as an equal provider of natural resources to all social classes, against the lived experience of water shortages and lacks in Mexico City. It upheld a vision of progress as an urbanised future, mediated by infrastructure and labour and their role in transforming nature, thought of as a god-given gift.

But his voice, and indeed that of other museum guides, were more than mere replicators of an official message or a unitary set of meanings. Little anecdotes restored the politicisation

waterproofing layer was added. It was not until 1991, when the water was diverted definitively, according to SACMEX workers that I worked with during my fieldwork, that a full restoration by INBA could take place.

The reason for the rapid deterioration of materials that were supposed to last over 40 years has been attributed to a number of things. The most widespread version is that which says that Dupont, the paint manufacturer, had lied to Diego Rivera and Ricardo Rivas, the architect in charge of building the chamber, and had overstated the durability of the material. Diego Rivera regretted his choice, and criticised the materials, framing the problem as one of commercialisation and the rule of the laws of offer and demand (Vargas Parra, 2012, p. 70)

that characterised mural art when it was being made (Carter, 2014)⁴⁶. Antonio was particularly fond of one. He often remembered the words of Raquel Tibol, an Argentina-born Mexican art critic who was close to Diego Rivera and other leading figures of Mexican muralism, on the reopening of the Distribution Chamber. According to Antonio, Tibol had said that the reason why the mural within had deteriorated so quickly was not due to faulty materials or false advertisement, the official explanation that was given ever since it happened. Instead, the problem would have been that Miguel Alemán, the Mexican president that inaugurated the Chamber back in 1951, had ordered to open the sluices that led into it before the paint had settled. He would have done this out of spite for Rivera. Alemán was embarking on an ambitious programme of capitalist modernisation in Mexico, and Rivera's overt communist ideas irritated him. He would not have this ideology, the story

⁴⁶ There are numerous debates around the question of mural art and its relation to the Mexican state (Carter, 2014; Craven, 2014). Revisionist readings not only of muralism (Folgarait, 1998), but of the revolution itself gained traction as the 71-year rule of the *Partido Revolucionario Institucional* (Institutional Revolutionary Party) came to an end. These depict the revolution (Córdova, 1973; Meyer, Krauze and Reyes, 1978) not as a popular uprising that led to major changes in the socioeconomic composition of Mexican society, but merely as an elite movement that changed the group in power without fundamentally altering relations of power and domination across the country. More recently, a post-revisionist history has been put forward (Knight, 1986), positing that the revolution was, in fact, three interconnected processes. One was the rural movement, led by figures such as Emiliano Zapata and Pancho Villa, and had a radical land redistribution agenda at its core. The second one was an urban movement, led by the incipient industrial proletariat, often with anarchist leanings. The third one was an elite movement, associated to landowners in northern Mexico, which sought a democratisation of the state, without necessarily pursuing a radical land redistribution or labour empowering agenda. This leads to a conception of the revolution in which radical demands made an impact, admittedly lesser than the one they put forward, even if they were later co-opted by the new ruling elite. Instead of thinking of the revolution as a monolithic process or movement, these approaches highlight the multiplicity inherent to this historical moment.

In muralism, this calls attention to the fact that mural art cannot simply be characterised as a materialisation of state power, as Folgarait has argued. Its transformation into official art (Coffey, 2012), instead of a revolutionary movement that sought to transform not only what art was, but also how the state would lead workers and peasants to a future of social equality and justice, came in second half of the 20th Century. This transformation implied reifying its meanings, conceptualising their calls for socialist futures as mere expressions of a bygone era and a personal conviction. Its transformation into official art also sought to hide the many divergences within the muralist movement. These included approaches to art, as mentioned in footnote 14, but also included political affiliations. Siqueiros was a staunch Stalinist and was involved in an assassination attempt against Leon Trotsky on 24 May 1940 (he was killed almost three months later, on 20 August 1940). In turn, Rivera was a Trotskyist, and close friends with the Soviet revolutionary. Far from being merely anecdotal, these divergences expressed themselves clearly in approaches to artistic materials, narratives, and techniques. Politicised art went beyond the personal affiliations of leading artists, and had a direct impact in the production of art forms, in act that echoes Benjamin's call for politicising art as a Communist practice (Benjamin, 2008, p. 42).

went on, pollute his great public work of modernisation and urbanisation, the Lerma System⁴⁷.

Many other stories made their way to the guided visits Antonio and his colleagues led. It is said that there used to be a hammer and sickle painted inside the tunnel that connects the Chamber to the Lerma, which was purposefully omitted when restoring the mural. Other anecdotes are not directly related to the painting. I was told that some of the engineers and topographers depicted in the southern wall still visited the site, often accompanied by their families. They went there to retell the stories of the construction, and to see their younger selves depicted in Rivera's work. Others said that scientists often visited the site, and corrected guides in relation to Rivera's theories of human and animal evolution, and in relation to his knowledge on chemical compounds and their formulas. One day I visited the site with a SACMEX worker, who was stationed 20 meters downhill and had never seen the Chamber from the inside. He was adamant that place had never been a functional infrastructure and was merely a decorative site dedicated to Rivera and his paintings.

These vignettes point to a more fundamental practice and process. The mural, as a site in which the promises of the Mexican post-revolutionary regimes regarding technology, labour, water, and social justice are made visible, is not self-explanatory nor self-sustaining. It requires the constant mediation of living labour, whether it is carried out by guides, cleaners, or restorers. This mediation does more than materialising an official narrative about art, state, or nature. While it certainly does so through the repetition of discourses generated by experts, themselves replicated in books (Tostado Gutiérrez, 2012), printed museum guides, and other media, it far exceeds this process. Through the repetition of unofficial stories,

⁴⁷ Elsewhere, the story told is that what pushed Alemán to move forward the inauguration date would have been the pressure to conclude the works, which had far extended their projected construction time (Vázquez Martín, 2012, p. 27).

often politicised and politicising, the museum guides open up space for diverging readings of the mural, and of its narrative, to be made. Infrastructural aesthetics and their registers are not something that simply stems from infrastructures' own materialities but instead are relational – constantly being made by both human and non-human others.

Infrastructural aesthetics also mediate how the promises of modernity, the power of the state, the claims of science, and the dreams of social justice are experienced by those who interact with infrastructural objects and relations. This can be seen in the ways in which the Chamber enables certain lived, affective, experiences in those who visit the space. In the case of those depicted in the mural itself, the monumental site appears not to be one in which the narratives of social justice and change dominate. Instead, their affective links to the place are preeminent, and lead their interactions with and through it. Scientists and experts also claimed a stake on the space by affirming their knowledge and challenging the narratives that the mural and its mediators put forward. Instead of a linear story, the site is open to multiplicity and dispute. These show how infrastructural aesthetics are not determined solely at the site of their production or maintenance but always implicate those who are interacting with them (Larkin, 2018).

The competing desires and interpretations visitors have regarding the Chamber can be explored not only through their interactions with guides, and the narratives the latter communicate about them. A review of one year of comments in the Distribution Chamber visitor book⁴⁸ showed that one of the main concerns that visitors had was the fact that they could not see the water anymore. Many asked for it to come back, taking the necessary

⁴⁸ Using visitor books as a way to understand how audiences interact with museum spaces has been previously developed in the field of museum studies (Macdonald, 2005; Coffee, 2013). Here, I do not seek to make a broader claim about how a museum operates, and what the roles of guides, materials, narratives, and visitors are. Whilst these are certainly relevant, in this chapter my focus is on the way in which these interactions offer a way to understand the making of narratives about nature, labour, infrastructure, nationhood, and the state.

provisions to protect the paintings. Many comments expressed this through nostalgic tropes, such as: 'imagine how beautiful it would be if we could still see water here'. Without water, visitors appeared to see the space as lacking the element that brought the mural to life. Despite this, many visitors marvelled at Rivera's mastery, mentioning that 'no one had ever managed to portray Mexicanness as he had'. No longer achieving the goals of unitary plastic, the mural had become for some a nostalgic celebration of nationhood, and, for others, a remembrance of the now distant promise of modernity and social justice that the Mexican post-revolutionary governments had made through infrastructure and art.

These promises are being constantly betrayed but are not completely broken. Not only is a narrative of state water provision through the Lerma still reproduced through museum guides, memory, and the mural and fountain themselves. At the same time, water still flows below the Distribution Chamber, and is still filling the four 50,000,000 litre deposits that supply the central boroughs of Mexico City. A new distribution chamber, this time built underground, is located behind the old one. Standing outside, the sounds and smells of chlorinated water can be perceived.⁴⁹ The dreams of equality amongst classes, however, are not materialised there. Before water makes it to the four deposits, a pipe is directed towards the wealthy neighbourhood of Polanco. Without the mediation of these deposits, and controlled by a valve that, according to its operator is always open, Polanco never runs out of water, receiving around 500 litres per person per day (Capilla Vilchis, 2018). Splintering here is not a result of neoliberal reform, but a feature built in the water grid itself. The modern ideal of universal, homogeneous water coverage did not make the leap outside Diego Rivera's mural. Instead, the promise of total water supply has been fulfilled only for some and remains elusive for many. However, even if as only a dim reflection of a once bright

⁴⁹ Inside, the flow of water is transformed into sounds through the sensors that make up an artistic intervention built on the site by artist Ariel Guzik. The intervention, called *Cámara Lambda*, has as its goal to replicate the sounds of the water that once flowed within the old Chamber (Ancira, 2015).

dream, social justice and the making of a state that supposedly ruled fairly over all still survive, multiple and ever-changing, within the four walls of the Chamber.

CONCLUSION

Infrastructural aesthetics have the promise of being a useful analytic to study how infrastructures are implicated in the historical and everyday making of power, inequality, space, and its modes of experiencing it. The joint analysis, through the heuristic of infrastructural registers, of material form, production and maintenance practices and forms of experience enabled through infrastructure contributes to the study of water urbanisation, state power and the role of labour both in the Lerma and beyond. Here I want to highlight one: how infrastructural aesthetics allows for a novel reading of heterogeneity in relation to the material form of infrastructure, to the socio-material relations that it enables as lived experience, historical process and to how these are shaped through often contentious everyday practices. None of the cases analysed here can be thought of as being a case of pure visibility, monumentality, or formality. Instead, the infrastructures analysed here are shaped by fluctuating, and sometimes conflicting, relations between these registers and their opposites. I suggest that these tensions, fluxes, and changes are not the result of deviations from an imagined norm, but rather a condition of infrastructure itself. These can be observed in the claims that elite and marginal groups make in and through infrastructures, or in the ways in which rust, decay and changing water flows challenge infrastructures' aesthetic functions and narratives.

Heterogeneity also refers to that of the socio-material relations and configurations that infrastructures enable and bring together. The Lerma System is entangled in the conjoint making of state power, urban water and urban space, and a modern order of urban living and citizenship. As a promise of plentiful and equal water supply the Lerma presupposes the

visibility of monumental infrastructures, the invisibility of resource making, and the formality and publicness of urban infrastructures. As a process both historical and quotidian, the Lerma System is characterised by the constant upending of these imagined orders. Informality, invisibility, and mundanity are present in relations and configurations in which they are supposed to be absent. Again, I suggest that this is neither a deviation nor a process of recent appearance in these infrastructures. Instead, it appears to be part of their historical making, and a condition of their everyday existence, which punctures urban life and urbanisation with difference and inequality, but also with possibilities of building forms of power, living, and meaning different to those of the state and its projected orders.

Considering this, I now draw some implications regarding three socio-material processes that are analysed in this chapter and how they might challenge dominant views on the matter. The first is the question of resource making and water commodification (Kaika & Swyngedouw, 2000; Swyngedouw, 2004). The sites analysed here lay bare some of the practices that can make water a non-fully commodified resource. In the Almoloya Plant, the discursive seamlessness of technological processes is challenged by the everyday practices of infrastructure operation. Instead of having a black box in which water is transformed from a local resource into an urban one, what is there is a leaky process, kept together with numerous patches. Still, it can be argued that the commodification of water is well under way there, as these patchy practices are hidden from view. However, the ones observed at the Reforma Well and Bosques de las Lomas show how heterogeneous infrastructural configurations make water as a multiple resource, changing even within the same water grid. There, alternative spaces of rule not only limit the action of the state as an environmental manager. They also show how the commodity form can be subverted, albeit limitedly, through localised processes of water production.

Conversely, in the Distribution Chamber there is not a deliberate effort to hide how water was made into a resource. Whilst the dream of lush orchards and clean swimming pools can hide the process of environmental transformation that the Lerma infrastructures brought about, the celebration of labour and technology seems to be aiming to show what the commodity form keeps occult. Instead of a representation of disembodied technology and abstract progress, there is an overtly political message that puts labour, and workers, at the centre. Resource and commodity making are decoupled as processes, without this meaning that the former is not leading to the widespread environmental degradation that is normally associated with the latter. Retrospectively, it can also be seen how the politicisation of resource making was subsumed by fixed discourses of nationhood and state power. In the museum, the celebration of the living labour of workers gives way to the enshrinement of Diego Rivera and his Mexican art. Despite this, through the narratives of workers and visitors, the multiplicities of water, national identity and state power appear, often surreptitiously and silently.

The second process is precisely that of statecraft and the aesthetic production of state power. In Bosques, wealthy elites exert porous control of space not only above ground, but also below. Through the deployment of securitised practices, whether human and non-human, these urban dwellers show how the reach of the state is challenged on an everyday basis. They do so not only through their encroachment of public infrastructures, but also through the racialized and class-based policing of workers and engineers. The state there is not an abstract order, whether legal or political. It is embodied, materialised, and maintained by these labourers and their practices. This embodiment has implications not only for the material control that the state can exert, through its bureaucracy, over infrastructures and urban space. It also indicates that the identity project of the Mexican post-revolutionary state is an unfulfilled promise on its everyday performances and practices. The splintering of

modernity is material and symbolic and can be analysed through the study of everyday interactions with and through infrastructure.

If on Diego Rivera's mural workers are portrayed as god-send messengers bearing the state-given gift of water, in the mundane infrastructural spaces of Bosques and the Reforma Well this is decidedly not the case. Instead of being such, they are seen as potential threats. For the elite, this threat is that of insecurity and violence, fuelled by the fear of the racialised other. For the disenfranchised population of *Colonia* Reforma, it is the threat of further injustices, driven by a history of dispossession and marginalisation. In both cases, it is not only the role of the workers that which is challenged, but also the power of the state as a set of practices and logics of nature and space production, management, and control enabled and materialised through infrastructures. In both cases, alternative spaces of rule appear, although these are never fully autonomous from the state. Instead, they are engaged in equally heterogeneous configurations, in which power is not a zero-sum outcome, but a negotiated, multiple set of changing and precarious socio-material stabilities. In this relational conception of power, the state appears not as a fixed, voracious, centralising machine, but as an uneven and unequal, yet changing, set of infrastructures, practices, and logics of space and nature production.

The last process is that of the production of modernity, understood as future-oriented project of urbanisation and nature production led by the state. It is clear that the promises of modern water supply remain unfulfilled in Mexico City. As the city grows, the dream of universal, homogenous service appears ever more distant. Narratives about future water scarcity have come to dominate the media, shedding light on the limits to the expansion of the urban resource frontier (Watts, 2015; Kimmelman, 2017). However, for many, scarcity is not new. Continuous water supply never came to be in much of Mexico City's periphery and hinterlands (Schwarz, 2017). There, as in the Reforma Well, heterogeneous infrastructural

configurations highlight how inequalities are made material, but also how they can be challenged and worked around. Far from being in a position of absolute abjection, marginalised urban dwellers creatively develop infrastructural solutions that allow for a different process of water supply. In these spaces, informality is not simply an opposite pole to formality, but is instead engaged in a productive, dynamic relation that punctures the homogenous ideals of modern service provision (see Baptista, 2019, for an analysis of electricity provision). These do not imply that inequality is subverted, but that non-networked solutions, patchy as they are, can be achieved outside the gaze of the state. This patchiness, moreover, is also characteristic of state work, and in particular of repair labour, as I will analyse in the following chapter.

6. PATCHWORK: ADAPTING INFRASTRUCTURAL CONFIGURATIONS THROUGH REPAIR LABOUR

INTRODUCTION

During the weekend, a leak had been flooding the parking lot of a corporate office building near a busy road intersection in an upscale Mexico City neighbourhood. Building administrators had been making calls to senior engineers and politicians, and a couple of SACMEX repair teams had been sent to fix the problem by Monday afternoon. There was already a big hole in the ground when I arrived there with one of these teams. Workers busily carried pavement, gravel and dirt out, whilst curious passers-by peeked, and exasperated drivers honked repeatedly. Pickaxes and shovels were used to break the ground, helping workers, knee-deep in water, find the leak. No plans or maps were in sight. Instead, workers found the leak through memory, experience, and gut feeling. After having stopped water flow partially and momentarily, a worker they called Gallo jumped in only to realize the provisional fix he had prepared, a *brazalete* (bracelet), did not fit properly. The pipe was six inches wide and the bracelet was five. Without any other fix in sight, Gallo resorted to improvisation. He put a piece of scrap metal beneath the bracelet where it did not cover the pipe completely. Using the force given by nuts and bolts, he managed to bend the piece of metal enough to transform the five-inch bracelet into a six-inch one. The leak stopped, at least for the time being.

Gallo's bracelet is just one instance of a widespread form of carrying out repair within Mexico City's networked water infrastructures, which I documented widely during the one-year ethnographic fieldwork that informs and sustains the arguments presented here. These instances were described by workers and engineers at SACMEX, the public utility in charge

of water supply and sanitation, as *parches* (patches). The word refers both to the material fixes that sustain the grid's operation and to the repair practices that workers carry out to make them. Amidst decaying budgets, precariously low wages, ongoing material ruination, the unpredictability of unwanted water flows, and a widespread lack of materials and tools, workers creatively repurpose discarded pieces, reassembling them into functional ones. Broken pumps are taken apart, their functioning parts stored for future use. Pipe sections are scaled up or down using improvised adaptors, transforming ill-fitting pieces into working ones. New tools are fashioned from scrap metal, allowing workers to carry out their labour beyond the provisions contained in planning documents and operation manuals.

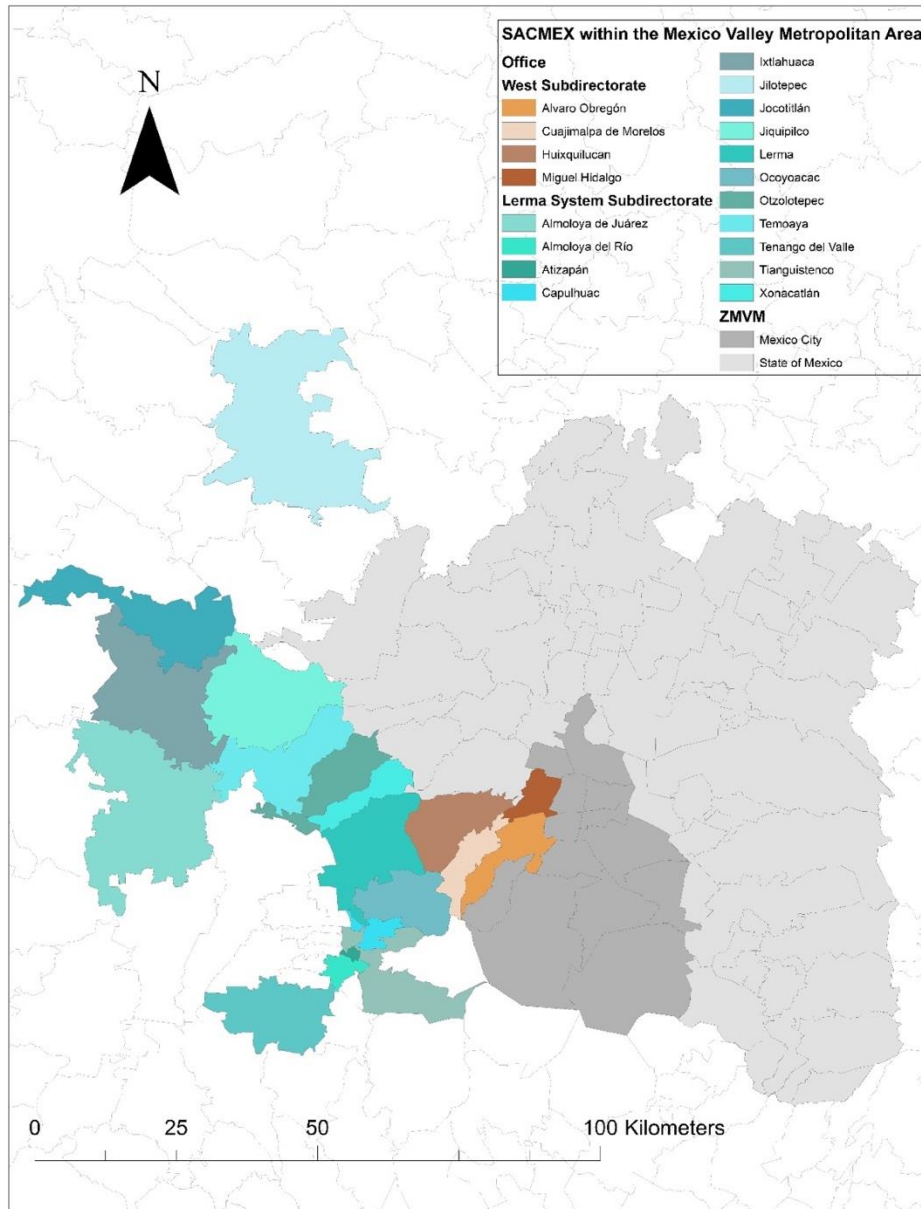
In this chapter, I build upon the workers' description by introducing the concept of patchwork to explain how hydraulic infrastructures, and the relations they bring together, endure in Mexico City through adaptive repair labour. I define patchwork as a repair practice, enabled by workers' embodied expertise (Björkman, 2018) and practical knowledge (Scott, 1998); as a repair logic, adaptive and improvisational; and as a socio-material form, related both to the materiality of infrastructure and to the relations that are enabled through it. Each of these meanings builds upon and challenges current research on repair and maintenance in distinct ways. It follows findings that highlight the importance of repair and maintenance in upholding not only infrastructures but also numerous relations that constitute state power (Barnes, 2017), urban inequality (Anand, 2017; Alda-Vidal, Kooy, & Rusca, 2018; Baptista, 2019), and urban life. However, patchwork allows for a conceptual move that expands the possibilities of this field of research. Namely, it proceeds by analytically separating the question of repair from that of maintenance. Instead of thinking them as an always joint practice and logic, patchwork stays with the question of repair as practice, and asks if other logics that exceed or transform that of maintenance might emerge.

Staying with repair as practice allows for a more careful consideration of how human labour works in and through infrastructure. Building on theorizations of repair and maintenance as improvisational and adaptive labour, driven by human ingenuity (Graham & Thrift, 2007), I push these arguments forward by considering how that work is learned, carried out, and how it emerges from the specific geohistorical context of the Mexico City networked water system. Namely, I show how patchwork is a result of structural austerity, widespread (yet unequal and uneven) infrastructural decay, and of the changing flows of urban water and urban soil. Patchwork is an improvisational logic that enables the city, and its many infrastructural configurations, to endure not by returning “to a former, officially authorized state” (Barnes, 2017: 154), but by adapting the grid to changing conditions and breakdowns, both foreseen and unforeseen, in ways that exceed and challenge official narratives, rules and practices. In staying with the question of repair, patchwork also stays with the moment of rupture, distinguishing between preventative logics of maintenance that seek to act before breakdown, and those of adaptation and improvisation that emerge as infrastructure fails.

Finally, patchwork contributes to our understanding of how formal networked infrastructures are materially produced in contexts of urban austerity and rapid socio-material change, and how these enable specific relations of power and difference. Building upon analyses of incrementalism in cities of the Global South (Silver, 2014), which focus on how marginalized urban dwellers convert diverse materials to configure new socio-material relations beyond the formal grid, here I expand these insights to interrogate the making of networked and formal systems. I find that incrementalism is also present in the networked system, and that it shapes not only its materiality but also the relations that it enables. These relate to questions of state power (Barnes, 2017) and urban inequality (Alda-Vidal, Kooy, & Rusca, 2018), but also to notions of urban modernity and infrastructure (Gandy, 2014;

Graham & Marvin, 2001). Namely, patchwork highlights how the endurance of modern ideals of networked supply are continuously achieved through patchwork as a practice and logic shaped by the materiality of water and infrastructure and enabled by the embodied expertise and practical knowledge of SACMEX workers.

This chapter zooms into the ethnographic accounts gathered through one-year participant observation with four SACMEX repair and maintenance teams, as discussed in the methodology chapter. Comprised of 5 to 7 workers, these crews were tasked with both routine inspections, and with repairs, both programmed and urgent. As I will address further ahead in this chapter, repairs far outnumbered maintenance jobs, shedding light into how the Lerma System operates. Two of these four teams were part of the Lerma Subdirectorate, based in the Lerma area of the state of Mexico. As mentioned elsewhere in this dissertation, the Lerma System, which taps onto waters both superficial and underground in this valley, supplies 12% of Mexico City's water (González Reynoso, 2016). The other two teams were part of the West Subdirectorate, working mainly in three Mexico City *delegaciones* (boroughs), and one state of Mexico municipality, as shown on Map 3. My role within these teams shifted as time went by. At the beginning I limited myself to observing, documenting, and carrying out informal interviews with workers; after two months, I started to help in carrying tools and materials, and towards the middle of my fieldwork, I started helping out in minor repair and maintenance activities, in particular with one team in Lerma. My analysis of workers' attitudes, resources, and practices when performing their labour comes not only from participant observation, but from this embodied research experience as well.



MAP 3. THE FIELD REVISITED. RESEARCH SITES IN MEXICO CITY AND THE STATE OF MEXICO⁵⁰

This methodological approach had profound consequences for the theorization of patchwork. My immersion in the field led me to consider the role of repair as practice in a way that I had not foreseen before heading to Mexico City. Whilst I expected that this often-unheralded work would be of the utmost importance for the networked pipe system, the

⁵⁰ Map by the author and J. Eduardo Ibarra-Olivo.

ubiquity, complexity and importance of patchwork far exceeded my expectations for causes that I hope this text makes clear. The rest of the chapter is structured around the three main contributions outlined before. First, I engage with the question of staying with repair as a practice. Building up on this, I follow by analyzing the logic of adaptation. Finally, I elaborate on what improvisation, adaptation and incrementalism mean for conceptions of formal networked hydraulic systems, and of urban modernity and infrastructure. I weave in theoretical discussions throughout the text, alongside methodological reflections. This has the goal of highlighting the relation between practice and theory, and the potential that ethnographic research has for conceptualizations of repair, maintenance, adaptation, infrastructure, and the relations that are enabled through these practices, logics and objects.

STAYING WITH REPAIR

Current scholarship on infrastructure repair and maintenance has highlighted the role these practices and logics have in sustaining not only material objects, but also the relations that are enabled through them. Contributing to previous work that focused on how infrastructures shape urban space and urban life (Gandy, 2005; 2014; Anand, 2017); enable the urbanization of different resources (Kaika, 2005; Kaika and Swyngedouw, 2000; Silver, 2015; Swyngedouw, 2004); and constitute diverse techno-political relations both in the city and beyond (Anand, 2011; Barnes, 2014; Björkman, 2015; Meehan, 2014; Von Schnitzler, 2008), repair and maintenance studies show how these relations and process are not self-sustaining but require constant work. This labour sustains, amongst others, hydraulic (Alda-Vidal, Kooy and Rusca, 2018) and energy infrastructures (Schwenkel, 2015), transportation systems (Denis and Pontille, 2014; Ureta, 2014), and housing (Chu, 2014; Strebel, 2011). At the same time, repair and maintenance enable the reproduction of forms of power (Barnes, 2017), urban inequality and numerous socio-material relations in the city and beyond (Carse, 2014; Graham and Thrift, 2007).

Despite the theoretical and empirical broadness of this field, there is a widespread conception of how repair and maintenance relate to each other. On these readings, the goal of repair is to ensure that a certain order, considered normal in specific geohistorical contexts, is maintained. This assertion often subordinates repair practices to maintenance logics or conflates practices of repair after breakdown with those of preventative action. Here, I want to critically interrogate this relation by staying with repair as a practice that is called upon in the moment of breakdown, distinguishing it from those that might be carried out before rupture takes place. I contend that this analytical distinction matters as it can surface how logics other than that of maintenance operate. This distinction implies separating practices such as the daily operation of hydraulic valves (Anand 2017; Alda-Vidal, Kooy and Rusca, 2018), the protection of certain infrastructures in response to a future threat, such as theft (Baptista, 2019), or the annual maintenance that enables water flow (Barnes, 2017) from those that follow breakdown. Staying with repair brings to the fore the specific work that this requires; advances our knowledge of how embodied expertise (Björkman, 2018) works; and allows for a more careful consideration of how certain socio-material relations are made adaptive in face of failure.

Empirically, this requires considering how repair relates to breakdown in two different ways. The first one concerns what practices workers carry out when infrastructure fails, how they do them, and to what ends. The second one considers why breakdown occurred in the way it did, considering the materiality of the Mexico City networked water grid, and how this same materiality shapes repair practices. The opening vignette, which briefly introduced Gallo's bracelet, can be a productive standpoint to interrogate this set of relations, as it makes visible the work of patchwork, and it positions it within SACMEX, the grid and their history. In what follows, I elaborate on Gallo's and his fellow workers' labour. I show how patchwork is shaped by workers' practical knowledge and embodied expertise. I also analyze

how patchwork is shaped by the materiality of water, rust, soil and austerity, and how the question of matter matters (Bakker & Bridge, 2006) when analyzing repair practices and their history. Afterwards, I highlight how these ways of knowing and doing are not shared equally amongst workers, how these differences matter in doing patchwork, and how they are part of a politics of repair in SACMEX.

DOING PATCHWORK

As Gallo worked, I stood at the edge of the hole the workers had dug to find the leak. Notebook in hand, I tried to write down everything I could. I was surprised by what then seemed like a paradox to me: that Gallo's patchwork fix seemed to be both improvised and thoroughly rehearsed at the same time. Before finding the leak, he and other workers had been trying to figure out just exactly where it was. They did this by observing the water's flow and by using their bodies to feel its pressure. The workers did not talk much as they pursued these clues. Instead they followed Gallo's lead, and moved with and against water's materiality. Tracing the leak was not done through deliberation but by deploying this form of embodied expertise. Recognized as crucial in mediating socio-political relations and imaginaries in and through infrastructure (Björkman, 2018), embodied expertise is also fundamental to the task of patchwork and the adaptation of hydraulic infrastructure and water flows in Mexico City. In the messiness of breakdown, embodied expertise allows workers to know where leaks and other problems are and enables them to patchily fix them. This embodied expertise is a form of practical knowledge (Scott, 1998). It resides not on manuals or official documents. It is not formally codified, and teaching and learning it does not take place through a separation of theory and practice. Instead, patchwork, as a set of unwritten rules, practical dispositions, and ways of thinking is developed through collective, iterative, and long-standing engagements with the diverse water infrastructures that make up the Mexico City water network. It is a practice-driven way of mending infrastructures that

relies on the ability to solve problems as they arise, drawing on previous practices of patchwork – and their success or failure. It is shared unequally amongst workers, as some have been able to develop these skills more than others, as a result of present and previous work experience, educational backgrounds, and other processes I discuss in the following section. It is also a form of work that is highly contingent on the materiality of each breakdown. No two patchwork fixes are identical, although many follow a similar logic and share numerous material characteristics.

Patchwork is a relational practice. It unfolds not by separating the workers from the site of breakdown, but through an ongoing consideration by the former of how the latter shapes their actions. In the Mexico City networked water system, well beyond Gallo's fix, four socio-material relations are paramount: soil, water, rust, and austerity. Soil matters in various ways. It is that which workers first encounter when trying to find a reported leak that is still underground. Whilst there are certainly some concrete breakers, excavators and backhoe diggers in SACMEX, much of the work of breaking the ground, both pavement and beneath, requires human work. Pickaxes, shovels and bare hands are all part of the removal of soil that enables to work on a leak or other forms of breakdown. Using these tools, as well as following water pressure and flow, calls for particular forms of embodied expertise that workers at SACMEX develop and use when doing patchwork. It is a way of doing and knowing that is shaped by soil, asphalt, and gravel, and that in turn shapes them.

Soil matters beyond this first encounter. Ground subsidence in Mexico City is a long-standing process, worsening unevenly across its territory. Driven by the exploitation of the underground aquifer, and by the geomorphological characteristics of the basin, soil sinks in the former lakebeds that make up much of the Mexican capital ground (Romero Lankao, 2010; Wester, 2009). The question of subsidence is particularly acute in the Historical Downtown, although it is increasingly more prevalent in the impoverished eastern borough of

Iztapalapa (Cabral-Cano, et al., 2008). Hydraulic infrastructures might breakdown as a result of subsidence and how this relates to other geophysical processes. In the aftermath of the 19th September 2017 earthquake, reports of broken-down pipes and aqueducts made the news (Aquino, 2017), and, according to engineers at SACMEX with whom I remain in contact with, also impacted their daily labour. Ground subsidence highlights how infrastructure, and the labour that allows it to function, are shaped relationally with other socio-material processes, and are in constant change and need of adaptation. As I will further elaborate, patchwork allows for this adaptation to happen, and in doing so makes hydraulic infrastructure work in the specific geohistorical context of Mexico City.

Water and rust come to matter together. Most of the piped grid in Mexico City is at least 50 years old and made of metal. New polyethylene pipes are just now being rolled out, and journalistic reports affirm that only 10% of the grid operates on this kind of plastic (Cullell, 2019). During fieldwork, I never observed a repair carried out on polyethylene pipes. It was always a question of fixing leaks in metal ones, worn down by the constant flow of water and the rusting of joints, valves and other pieces. Inside pipes, rust comes together with soil and other materials dragged by water, reducing the space through which water flows, and increasing the pressure in ways that might puncture them, leading to leaks. It is precisely in one of such occasions where Gallo's bracelet was called upon, as it allowed the leak to be contained without having to fully stop the flow of water and changing the piece altogether. This ideal solution, workers acknowledged, would be far more enduring than any single instance of patchwork, yet it was hard to achieve. This was not only because stopping water flow for an indeterminate amount of time was a difficult question to negotiate with neighbors and users, but also because rusty valves often cannot fully stop the flow of water. This was indeed the case when Gallo patchily carried out his fix, even if water kept steadily dripping.

The possibility of replacing these everyday pieces was further curtailed by the deepening austerity that SACMEX has faced over the course of at least three decades (De Alba, 2017). Workers identified 1997, the year when an opposition candidate was first elected as Mexico City mayor, as the moment in which funding became increasingly scarce (although De Alba suggests that this might have been ongoing since the early 1990s). For them, this was a consequence of a shift in the relations between the city and the federal government, and a way to pressure local authorities amidst a political struggle that had important consequences for their work and for urban life. Many workers recalled a previous time when materials had been abundant, and more thorough fixes were possible. For others, austerity was all they had known. Crucially, austerity means not only less materials but also less staff being recruited, meagre or inexistent wage increases, and lack of training for workers. Patchwork becomes more and more significant in this material context, as it enables the grid to function despite decreasing budgets, material lack, and deepening neglect. In 2019, SACMEX budget received a significant increase (Noticieros Televisa, 2019). Although this does not reverse decades of insufficient funding, it might still have important consequences for patchwork and the role it plays within the networked grid.

When Gallo jumped inside the hole, and began searching for the leak, all these material relations were at play. Soil had to be broken and maneuvered with. Water pressure was felt and followed. Rust impeded the fully closure of the valve that controlled that pipe section. Austerity meant that those valves, as well as the pieces required for a more durable fix, were not available. Patchwork, as a repair practice enabled by workers' embodied forms of expertise and practical knowledge, is what allowed the leak to be fixed, and service provision to continue. Patchwork is also significant in many other sites of breakdown. Malfunctioning pumps, broken engines and missing measurement devices can all be fixed by the creative use of discarded pieces, mismatching pipes made fitting through diverse material interventions, or the repurposing of materials that were not originally designed to be used

within a networked pipe system, such as the scrap metal piece that Gallo used. Patchwork, as opposed to maintenance, sustains the working of the grid but does so not by returning it to a previously stable, officially sanctioned state, but by adapting the grid to changing material conditions through small-scale interventions.

Repair politics

Repair practices, current scholarship shows, are always already political, entangled with the maintenance of relations of power and inequality across different scales and amongst different actors, including the state, informal neighbourhoods, private providers, and international experts (Alda-Vidal, Kooy, & Rusca, 2018; Anand, 2015; Baptista, 2019; Barnes, 2017). In what follows, I highlight three ways in which patchwork contributes to our understanding of repair politics. The first one concerns how skill, practical knowledge and embodied expertise shape work team hierarchies, and how this in turn shapes how patchwork is carried out and the form that infrastructure takes. The second one concerns the position that manual workers occupy within SACMEX's institutional hierarchies, and how patchwork fleetingly upends official relations, highlighting the role and relevance of manual labour. The final one concerns how patchwork is shaped by the different forms of pressure (Anand, 2011) that urban dwellers are able to put on SACMEX and Mexico City government officials, and how this pressure is in turn shaped by the different relations that dwellers have with infrastructure and water supply.

Patchwork plays a fundamental role in structuring work teams. Whilst all team members must do their part, what these are and what they mean for the practice of patchwork greatly differ. Newcomers are often engaged in the most extenuating and less creative practices. They carry pipes, load and unload trucks, and provide overall support for their teams (as I did during my time at SACMEX). This is certainly not always the case, as some new workers already have mechanical skills that allow them to carry out patchwork practices with more

efficiency and dexterity. This division of labour often mirrors formal hierarchies and relations of authority within teams. The patchwork-related abilities and knowledges of some workers were often described by their peers as virtuous and were recognized as sources of prestige and distinction. These workers were usually appointed foremen, often elected by or in consultation with their peers. Skill differentials are related to workers' biographies, and to opportunities to develop skills that both include and precede their employment at SACMEX. Some workers had been employed in factories before or had had the opportunity to access technical education. Others had only been able to finish elementary school or had worked in entirely different activities before. The former not only had particular patchwork skills but were also able to move upwards within SACMEX, often remaining longer at their positions and developing their abilities even further.

I often observed heated discussions amongst members of the same work teams when deciding how to repair different breakdowns. Foremen and deputy foremen usually led, and the solutions they devised, such as making makeshift adaptors to connect mismatching pipes with pumps or putting together the working parts of two broken-down pumps to make a new functional one, were followed. At other times, foremen decided that a patchwork solution was not sufficient, as the specific problem encountered might be worsened if just patched and, for example, a malfunctioning electrical piece was not replaced. On one of such occasions, a worker challenged the decision made by his foreman. He said that he had called their boss, Hernán, and he had recommended carrying out the patchy solution of merely rewiring a pump engine and not changing a whole piece, as the foreman intended. We later found out that the call never took place, but the episode highlights how decisions on how to carry patchwork are also political. They are related to hierarchies within teams and between them and SACMEX at large, to shared perceptions of others' skills, and to the capacity to imagine, improvise and repair diverse breakdowns. These decisions matter as they mean that

particular forms of patchwork come to shape the grid, and often become prominent elements of the patchwork repertoires shared by workers across SACMEX.

There are still other inequalities at play within work teams. One of great importance is the question of income. Whilst basic wages are similar, as all workers are officially employed as 'Operations Assistant in Urban Services', located at the very bottom of the SACMEX organizational chart, there are several contractual situations that might increase or decrease their income. If a worker misses a workday without explicit authorization from the office to which he is ascribed, penalties are issued which can result in monthly incomes of less than half of the \$4,500 pesos that workers earn on average, according to documents I observed during fieldwork. These workers often have more lucrative employment elsewhere, as taxi drivers, construction or factory workers, yet many of these side jobs do not provide the minimum social security (pension, health, and housing) that SACMEX positions do. However, some of these provisions are not readily accessible for all. A case in point is the question of overtime pay. Whilst some workers do receive this additional income, others do not. This is related to the fact that workers might only become permanent following five years of continuous labour, after which they can become part of the negotiations that the local branch of the state workers union carry out with the central SACMEX administration. Overtime pay can double a worker's income, and therefore are the source of many disagreements, desires, and discussions.

Workers often reflect on the relevance of patchwork, and how its practice enables infrastructures to function despite ongoing deterioration and austerity. They claim a centrality to their work that I seek to echo in this article. Yet, despite its importance, they acknowledge it is a marginalized practice – something that is reflected in their low wages and their official position within SACMEX. In most (but certainly not all) everyday interactions, workers' practical knowledge is made to be secondary to the that which engineers deploy

through maps, other documents, formal knowledge, and ways of speaking and dressing (see Barnes, 2017 for a relevant discussion on this topic). Engineers have different relations to manual workers, but those in higher positions often consider their solutions and knowledge to be mere placeholders for future large-scale interventions that have so far failed to materialize. Even my interest of researching workers' practices was often greeted with puzzled looks, as senior engineers did not think there was much worth analyzing there. This contrasts greatly with workers' perceptions of this divide. They often complained that high-ranking officers and bureaucrats within SACMEX have never seen how everyday labour looks like, and therefore are unable to understand their work and what it does.

However, repair highlights the crucial role that patchwork plays in enabling the grid to adapt amidst austerity and decay. Field engineers know this, and do not regularly stand in the way of patchwork when the situation calls for it. If anything, they call upon workers' practical knowledge and embodied expertise in moments in which hierarchies become flipped, even if they do so fleetingly. When facing a repair that cannot be solved according to the formal rules and manuals within SACMEX, engineers often delegate the responsibilities to manual workers. On many occasions, engineers are not present, as multiple breakdowns, and the patchwork that momentarily solves them, are not exceptions but part of the grid's everyday work. Additionally, practical knowledge is also resorted to when engaging with infrastructures that are not fully included in formal ways of knowing the system, such as logs, plans, or maps. For example: in the absence of accurate or updated plans, it is often said that a full water grid map only exists in their minds and memories. It is them who can pinpoint where valves are located, or how pipes were rearranged in some previous repair process. Workers' practical knowledge makes up for the ways in which networked hydraulic infrastructures exceed top-down tools for describing and understanding infrastructures, their connections and breakdowns.

The moment of breakdown and its aftermath are also being shaped by other political relations. How quickly response takes place is related to how much pressure (Anand, 2011) different groups of urban dwellers can exert on SACMEX and government officials. Often, this pressure travels not by official means but by diverse technologies, such as instant messaging tools. These same technologies are used to transmit orders to workers, who then might solve any given breakdown through patchwork. The flow of water in Mexico City is often enabled by these non-formal, non-official ways of doing, even if they take place within the publicly owned, networked system. At the same time, patchwork is called upon differently by the pressure that any unwanted flow might have on the rest of the grid. Breakdowns on distribution pipes, or in those that affect water distribution tanks, pumps or engines are often prioritized over those that take place in the margins of the grid. This material pressure often coincides with spatial inequalities, which are in turn related to the kinds of pressure different groups, companies and neighbourhood can exert. Patchwork responds to socio-material pressure, enabling both the grid and officials to fulfil their functions and sustain urban flows.

After Gallo's bracelet was put in place, I sat down at a nearby curb with several workers. They were curious about my presence, made even more evident by my frantic notetaking. I told them I was doing research on how they kept the grid working, and that I was keen to understand what they thought was relevant. They reflected on the strenuousness of their work and on its punctured temporality. Patchwork was called upon at moments when breakdown disrupted flow in such a way that a solution could not be prolonged, and the imperative of repair demanded creativity and improvisation. Patchwork, as a practice carried out by workers within the public utility, also has a distinct spatiality. Its presence is shaped by pressure, as the relatively rapid response to the leak that Gallo fixed suggests. As we looked at the now dry hole from afar, one of the workers told me a story of how a leak in a self-constructed neighbourhood in one of Mexico City's many ravines was only found when

a landslide forced the government's attention. After assessing the situation, the workers found the issue: the roots of a tree had broken a pipe, causing a leak that went on, according to this worker's calculations, for at least 15 years.

In this section, I have stayed with the question of repair and how it unfolds at the moment of breakdown. I have shown how patchwork is a relational practice, shaped both by workers' previous experiences of repair and by the materiality of Mexico City's infrastructure. I have highlighted how specific geo-historical conditions shape patchwork, whether as a result of ground subsidence, structural austerity or infrastructural deterioration and decay. I have also analyzed how patchwork is a political practice, shaped and shaping inequalities and hierarchies within the work teams, across SACMEX, and at the urban scale. In doing so, I have enriched existing empirical and conceptual discussions on repair as practice. I have done so by separating the work of practice from the logic of maintenance, which are often discussed together. In existing literature, this stance can be related to empirical lacunae, where manual work remained beyond the scope of research (Barnes, 2017), or to conceptual frameworks, where pre-emptive work of maintenance is brought together with the adaptive work of repair (Baptista, 2019) or that of infrastructure operation (Anand, 2017; Alda-Vidal, Kooy and Rusca, 2018). In staying with repair, I have opened the space to analyze how other logics, namely that of adaptation, shape and are shaped by patchwork. This is what I now turn to.

THE LOGIC OF ADAPTATION

ANTICIPATING BREAKDOWN

Much previous labour was needed for Gallo to be able to carry out his patchwork fix. If the moment of rupture highlights the improvisational character of patchwork, its reliance on embodied expertise and practical knowledge, and how it responds to breakdown materiality, also suggests that some form of anticipation might be at play. That Gallo had pieces of scrap metal lying around in the back of the truck he shares with his team points to this. As I carried

out fieldwork and became more and more engaged with the everyday activities of workers across SACMEX, I got to observe and participate in these anticipatory practices and logics. They take place not at the moment of breakdown but at the warehouses and yards where workers wait for the next call. Despite this physical and temporal distance, breakdown remains a pressing concern and a future certainty. Whilst the specificity of each instance of disrepair is unknown as workers prepare the materials and fixes they might use in the future, their experiences of previous patchwork allow them to anticipate not in the dark but in light of what usually happens within the Mexico City water grid.

Artemio and Pablo work at a different sector than Gallo. They too are part of a repair team, although their main tasks have to do with fixing pumps and engines rather than pipes, given that their sector – Lerma – is where 12% of the total Mexico City water is extracted. Their work has a different pace. If in central Mexico City emergency calls and breakdowns that exert pressure on officials, workers and engineers are most common, in Lerma failures are less frequent, more distant and require different technical adaptations. Whereas Gallo's bracelet acts upon infrastructure as a form to contain excess water, the patchwork fixes that Artemio and Pablo carry out are normally concerned with getting water out of the ground. This usually implies working not only with metal pipes but with the many electrical and mechanical components that allow pumps and engines to function. This added technical complexity, added to the slower pace of repair labour, means that anticipatory practices are more visible in Lerma than in most of the sites I could observe in Mexico City.

When days were slow, Artemio and Pablo spent a good amount of time in their sector's warehouse. There, they stored spare pieces, tools, and cables out in the open and in a seemingly disorganized way (Figure 22). Malfunctioning pumps, engine parts, pipe sections, hammers, pliers and many more objects were lying around, some rusty and some still covered in mud and water. This disorder, however, was only apparent. Both workers, and

indeed others, knew what was kept there, and how it might be put to work. I often sat with them as they took the time to find out what was available and figure out how to use it when breakdown finally happened. They also prepared other fixes in advance: on several occasions, they assembled longer cables from short pieces that had been left over from a previous repair using tin solder they heated on a small charcoal stove and insulating cable. They did so with the ease that comes from practice and, eventually, mastery over the process. Whilst working, they often discussed future patchwork fixes and how their present labour might come in handy then. Driven by the imperative of sustaining water flow and understanding the relevance of their labour in achieving so, Pablo and Artemio speculated not only about repair but also about socio-material change and its relative unpredictability.



FIGURE 22. ADAPTATION MATERIALITIES. DISCARDES PIECES AWAITING CONVERSION AT A LERMA WAREHOUSE.

Anticipation and speculation are integral parts of what I name as the logic of adaptation. When workers prepare fixes in advance, considering how breakdown may occur in the nearby future, and how their current actions can influence their forthcoming ones, they are working with a set of relations that are in continuous flow. Whereas most of current literature on maintenance highlights the role of repair in returning relations and objects to a “former, officially authorized state” (Barnes, 2017: 154), here the concern is not with what is officially sanctioned but with what might just work. This anticipatory and speculative labour is different from the preventative one that characterizes maintenance (Baptista, 2019), as it is done always in relation to the moment of breakdown and not with the intention of impeding or delaying it. In this it differs too from the work of operating infrastructures (see Anand, 2017; Alda-Vidal, Kooy and Rusca, 2018, and the arguments presented in the following chapter), as it is not concerned with sustaining an already ongoing flow but with restoring one that has stopped amidst continuous socio-material change. Relations and things do not go necessarily back to officially authorized states but often are repaired in ways that both make previously existing relations endure and allow infrastructures and configurations to adapt.

This concern with the encounter, namely with the moment in which breakdown calls upon patchwork as a repair practice, can also be deployed to understand what the role and specificity of human labour is and what are its socio-material limits. Anticipation and speculation always imply a degree of unknowability. Workers may know what kinds of breakdown are more common, and sites where this occurs more often – the place where Gallo fixed the leak being a case in point. However, their calculations cannot fully account for the specificities of each failure site. The concern is not with repairing these breakdowns as they should be, but instead with fixing them as they can. In doing so, workers are operating within the boundaries and limits set by existing infrastructures and by the materials and

knowledge available to them. Their goal there is not to return things to their ideal or original form, but to fashion normality as an ongoing process that is always shaped by infrastructure and other socio-material relations. However, anticipation and speculation, and certainly improvisation at the moment of breakdown, suggest a purposefulness that is specific to human labour. Patchwork is indeed a hybrid process (Gandy, 2005), yet one in which human work plays a specific role. The consequences of this specificity can be also observed in the material form that infrastructure takes and on what this materiality implies.

INCREMENTAL LABOUR AND THE FORMAL GRID

Whenever a patchwork fix is installed, the grid does not go back to adhere to its original design and to the materials that were used when it was first built. Instead, new materials and new designs become part of it, often bearing the marks of specific workers and their ways of doing patchwork. This small-scale adaptation can be thought of as a form of incrementality (Silver, 2014). These, and the practices of infrastructure convertibility associated to them, have been richly explored in cities of the Global South (Simone, 2004; 2013). There, they are what enables the urban majorities to make spaces for living amidst precarious and uncertain conditions. Through these practices and logics, alternative forms of service provision are achieved through collective experimentation, always making the most of what is at hand. Not unlike these forms of incrementality, patchwork also relies on collective experimentation, as ways of doing patchwork are learned by doing together. The logic of adaptation also requires the conversion of discarded pieces, scrap metal and malfunctioning infrastructures to construct new working ones that might be used when breakdown occurs. Amidst ongoing austerity, precarious wages and insufficient materials, workers make do with whatever is at hand in navigating uncertainty and disrepair.

However, patchwork is different from other forms of incrementality insofar it works not on spaces of informality and heterogeneity, but on those characterized as formal and

standardized. Moreover, it is carried out by public workers under the purposefully distracted gaze of field engineers and other SACMEX officials, and not by urban dwellers in the margins or beyond formal networks and the state. Patchwork is neither fully official nor completely unofficial. It exists in an in-between where improvisation, adaptation, and incrementality allow urban water to flow through the formal, state-owned and publicly operated network. Against ideals of standardized infrastructure, it is patchwork what enables infrastructure to function. It does so not through thorough planning, but through a calculation of probabilities and the deployment of ways of knowing and doing based on previous practices and experiences. These do not aim to offer definitive solutions, and neither can ensure that decay is definitely fended off. Instead, patchwork only promises (Anand, Gupta, & Appel, 2018) to deliver something that works for a limited period, and that to do so must adapt infrastructures materially through human labour. Patchwork is always facing the uncertain, reminding us that “long histories repetition need not constitute likely guarantees.” (Simone, 2013, p. 245) What worked before might not do so in the future, as the city, infrastructure, soil, water and labour change constantly and in often unexpected ways.

Moreover, the political stakes of incrementality in the formal grid are different from those that characterize many of the heterogeneous infrastructural configurations (Lawhon, Nilsson, Silver, Ernstson, & Lwasa, 2018) of cities across the Global South. Patchwork does not necessarily prefigure new forms of producing infrastructure and resource flows, as other forms of incrementality might do (Silver, 2014). Instead, it shows how these practices can also be deployed to ensure that already existing infrastructures and flows are sustained through adaptive labour. These, despite being constantly achieved and always in the making, are adapted in temporalities and spatialities saturated by the accretions of previous infrastructure (Anand, 2017), and the intransigence (Collier, 2011; Carse, 2014) of their forms and the relations they enable. Patchwork highlights how repair does not necessary entail a

return to officially authorized orders – although it most certainly does so in many cases and geographies. Instead, it shows that it can also be part of the constant adaptation of infrastructures and the many relations that exist through and within them, often challenging or exceeding officially sanctioned practices and rules.

PATCHWORKING URBAN MODERNITY

Studies of hydraulic infrastructures and modernity in Mexico City highlight three characteristics. First, they show how the construction of standardized infrastructure monopolies (Graham & Marvin, 2001) was an ideal shared by Mexican elites since, at least, the end of the 19th Century (Perló Cohen, 1999; Vitz, 2018). Second, that this ideal was always already exclusionary, and that it deepened already existing spatial differences linked to racial and class inequalities, which endure today and might deepen in the future (Romero Lankao, 2010). Third, that this stark difference and inequality represents an unfinished (Duhau & Girola, 1990) or lagging modernity (Sánchez-Mejorada Fernández, 2005), where the formal, central city stands in contrast and opposition to the sprawling, informal, unplanned peripheries. This body of work rightly emphasizes the historical and contemporary inequalities that characterize the Mexican capital, where behind the 97% formal coverage of the networked pipe system (CONAGUA, 2018), realities of intermittent supply, poor water quality and heterogeneity proliferate (de Alba, 2017; Schwarz, 2017). However, this focus has left the central city largely unexplored, being depicted as a site where the modern infrastructural ideal was and is put in practice.

Patchwork contributes to the study of urban modernity, in particular in relation to water supply and urbanisation, in Mexico City by unsettling the supposed stability of formal supply, querying the somewhat forgotten space of the planned city and its networked water infrastructures. Take Gallo's bracelet into consideration yet again. It temporarily solves a problem in the formal network through an ad-hoc intervention that he learned through

constant engagement with the field, and that relies on his practical knowledge and embodied expertise. This fix does not adhere to any officially sanctioned rulebook, nor does it ensure the standardization and engineered planning that characterizes urban modernity. Instead, patchwork as practice and logic challenges already existing standards and norms, and in doing so it enables the production of a differently modern infrastructure, still operating but not through standards, rules and codes but through ad-hoc, incremental adaptations, not unlike the heterogeneity present at the Reforma well. The promise of reliable and constant supply that characterizes planned Mexico City, and the socio-material relations this enables, endure not by returning to a previously existing order but by adapting the grid to changing conditions through patchwork. Instead of a stark opposition between formal and informal, planned and unplanned, and heterogeneous and unitary infrastructure and urban space, there is a more fluid set of relations that are enabled and adapted through human labour. Crucially, this work is not that of engineers and planners, who often do not know how patchwork is carried out and its adaptive logic. Instead, it is the labour of manual workers that is called upon, alongside their forms of knowing and doing, practical and embodied.

That even the central city does not adhere to ideals of standardized, unitary infrastructure, and to the rule of official planning and engineering, does not imply that distinctions between it and the unplanned city are unimportant. Indeed, the fact that leaks go unnoticed for decades in the self-built peripheries attests to their continued relevance. These already existing inequalities are compounded by the uneven presence of patchwork, and the ways in which pressure shapes these fixes and calls upon workers' labour differentially. These inequalities are also linked to different attitudes towards manual workers across Mexico City. When carrying out patchwork fixes in the central city, workers were often challenged by neighbors and employees working at the affected households and offices. Their presence was sometimes perceived as a nuisance that punctured the normal flow of water, even if it was required to restore it through patchwork. In contrast, in the periphery they were mostly

greeted with a mix of relief and indignation, as the workers became not only those who repair infrastructures, but SACMEX representatives, even if only momentarily.

This fleeting role of workers as government representatives echoes arguments regarding the proliferation of intermediaries in the peripheries of Mexico City (de Alba, 2017). There, these intermediaries both challenge and enable the continued participation of the state in the tasks of water supply, often through heterogeneous infrastructural configurations. Here, the stakes are different, as SACMEX workers enable the participation of the state in the provision of water, but do so not in ways that directly challenge the state's political authority, as they do not become intermediaries that construct alternative forms of territorialized power through hydraulic infrastructures. Instead, their challenge works at the scale of infrastructure, as it both upends momentarily the established hierarchies within SACMEX, and it highlights how the endurance of urban modernity requires improvisational and incremental labour. Indeed, workers are crucial in sustaining the role of the state in the provision of urban modernity through an infrastructure monopoly, yet they do so in ways that challenge assumptions about standardization and the formality of the piped network and the seamlessness of the unitary city. At the same time, their relative autonomy shows how their practices cannot be conceptualized as only executing orders drafted elsewhere but must be queried as operating according to their own geo-historically specific characteristics and logics.

The role of patchwork in the adaptation of the formal network, and in the provision of urban modernity, echoes findings from other cities and spaces across the Global South. The constant work that infrastructures require resonates with notions of service provision being always in the making (Baptista, 2019). Unfinished and ongoing, infrastructure and the relations it enables are constantly being adapted in relation to changing socio-material conditions. Certainly, this work is not beyond the maintenance of certain entrenched forms

of inequality. This both relates to workers own notions of order, disorder, and their territorial correlates in urban space (Alda-Vidal, Kooy, & Rusca, 2018), as well as to the different forms of pressure that urban dwellers, public officials and bureaucrats exert (Anand, 2011). In carrying out patchwork, workers sustain the role of the state in providing water, proving that this type of labour is necessary for it to endure (Barnes, 2017). At the same time, the way in which patchwork is called upon differently across the unequal and uneven geographies of Mexico City highlights how indeed the city has been historically shaped by differentiated access to water and sanitation, not unlike other metropolises in the Global South (Anand, 2017; Gandy, 2008). The city is a site of fractured modernity (Gandy, 2014), where risk and disease are distributed unequally, and where class and racial inequality follow lines of uneven water and sanitation access.

However, patchwork also contributes to this body of work in specific and novel ways, complementing and challenging our knowledge about how modernity, as an infrastructural configuration, is made, repaired and adapted, particularly in contexts of ongoing and deepening disrepair and decay. In the planned and networked central Mexico City, it is patchwork that which allows water to flow and infrastructures to be adapted to changing socio-material relations. It does so not by returning infrastructure to a previously approved official order, or by preventing failure. Instead, it works always at the moment of breakdown, and through an adaptive logic that challenges and exceeds official norms, rules and ways of doing. Patchwork, as a way of doing that is not only shaped by practical knowledge but enacted through embodied forms of expertise, shapes infrastructure in ways that are not standardized, but neither incommensurable. This means not only that modernity is plural and adaptive, as already highlighted by numerous works on the urban condition in Mexico City and elsewhere in the Global South, but that manual work, namely that of repair, has a crucial role in enabling this. Crucially, patchwork shines light on the central city and the formal grid, often assumed unproblematically modern. If modernity in Mexico City is not only

fractured but constantly being patched, it could be relevant to query whether these practices and logics are present elsewhere, bearing different names and being the result of specific geohistorical processes and changing socio-material conditions.

CONCLUSION

This chapter has developed the concept of patchwork to understand how repair practices are carried out in the Mexico City networked water system. The concept follows manual workers' own descriptions of their labour, and of the way in which it relates to infrastructure in a context of structural austerity, widespread material breakdown, subsiding soils, depleting aquifers and precarious employment conditions. Analytically, patchwork is mobilized by separating repair practice from maintenance logics, which I analyse elsewhere in this dissertation. This move allows me to further elaborate on how repair is done, to what end and through which means. I find that repair does not necessarily imply the return to officially sanctioned configurations but might instead enable infrastructural configurations to adapt to changing socio-material conditions in ways that are shaped by improvisational labour and the situated politics of patchwork. I elaborate on this by exploring the logic of adaptation. I show how it relies on anticipatory and speculative thinking, yet always remains rooted in the moment of breakdown as a paradoxical certainty: its occurrence is given but the specific shape it might take is not fully known in advance. In this it differs from maintenance, which also includes preventative actions that seek to avoid breakdown, and those of operation that assume ongoing flow.

When thinking of adaptation in relation to the materiality of the grid, I show how patchwork is an incremental practice that differs from others insofar it is carried out by state workers on the publicly owned grid. There, incrementality does not produce a quilt-like heterogeneous configuration that prefigures other forms of service provision and infrastructure, but rather sustains existing ones through constant patching. That these repair practices do not adhere

to official ways of doing and planning shows how the functioning of the planned, formal network, particularly in the relatively unexplored space of central Mexico City, relies also on unplanned practices. Their presence and role, allowed by SACMEX officials as it sustains water flow in austerity and breakdown conditions, show that the current work of modern infrastructural configurations do not mirror the ideals that drove their construction. Instead, they are enabled by patchwork as an incremental, improvisational and adaptive practice and logic. This echoes arguments that depict urban modernity in the Global South as plural, unequal and adaptive, but contributes distinctively by highlighting the role that manual work, in particular that of repair, does on the formal grid. Patchwork might be present elsewhere, perhaps under different names and through diverse local practices, but still playing a fundamental role in adapting infrastructures and socio-material relations to continuous change.

Beyond repair practices, the boundaries between formal and informal or planned and unplanned are constantly blurred in the everyday work that sustains the water grid in Mexico City. The stakes of these other sites are different, as they are not concerned with the question of breakdown and repair. Instead, they work at the scale of everyday operation. There, the main problem is one that I have already hinted at here: the unknown. Workers might not know what kinds of breakdown are more common, but they do not know when, how and why it will happen, or how it will be solved. Similarly, engineers and bureaucrats face questions of unknownability constantly. To manage the grid, they recur to various forms of speculation, anticipation, memory and affect. These too are central in sustaining urban modernity and water urbanisation in Mexico City. They are also crucial in maintaining the state and its control over infrastructure and water flow, particularly in a context of widespread decay, austerity and botched modernisation. I analyse these questions in the final empirical chapter of this dissertation, highlighting how the unknown plays a

fundamental role in the everyday labour across SACMEX, and how it calls for specific work practices and knowledges.

7. MANAGING THE UNKNOWN: EXPERTISE, NATURE, AND INFRASTRUCTURE

INTRODUCTION

42%. This is the percentage of water that is said to be lost daily in Mexico City (SACMEX, 2018). It is often used to represent the magnitude of the city's water supply and management problems. However, this number hides and conflates many things behind its straightforward simplicity. To begin with, it includes both the losses attributed to leaks; to illegal connections to the grid, and to metering malfunctions and tampering. Secondly, it is not measured but estimated. While there are certainly numerical data, statistics, and hydrological measurements within SACMEX, these are insufficient to produce a number that would represent the water losses issue in a precise manner. Missing measuring equipment, and unable to physically supervise each point in which water could be spilling out of the grid, SACMEX experts and workers resort to calculations and estimations. In the case of water losses, these are made by comparing how much water is 'produced' in relation to that which is 'invoiced', and correlating this to the 'leak incidence' in the water grid (although the actual terms and results of this correlation are not publicly known) (SACMEX, 2018, p. 62). 42%, often presented as 40% or 35%, is a number that highlights how the unknown is part of the planning and administration of the Mexico City water grid.

The problem of managing the unknown is one that SACMEX engineers, workers, and bureaucrats face constantly. It is not limited to the question of losses and leakage. The sprawling Mexico City water grid – 13,978 kilometres long if the aqueducts, primary grid, and secondary grid are considered – routinely escapes calculations, representations, measurements, surveys, and other formal ways of knowing. Plans do not encompass the totality of the grid; leaks and other unaccounted flows proliferate, often far from SACMEX's

sight, and measurements of existing water levels in deposits across the city exceed the company's technological and physical supervision capabilities. In this chapter, I will analyse how these unknown quantities, infrastructures, spaces, and flows are brought into being and under the gaze of the state and its experts. I shall do so by exploring how low and middle-level bureaucrats and engineers resort to affect, calculation, speculation, and memory when filling the gaps that exist in the formal knowledge there is about the water grid. My argument is that this labour of making the unknown knowable is necessary to produce the water grid as a stable system, water as a measurable object, and the state as a set of procedures that can control and manage natural resources through infrastructures.

These practical forms of knowledge emerge as the result of two simultaneous processes. The first one are the progressive and deepening budgetary cuts that SACMEX has faced after 1997, and which reached a critical point in 2017 (Martínez Omaña, 2002; Morales, 2016; SACMEX, 2018). I will show how the absence of measuring technologies and sufficient personnel prompts workers to deploy calculative, speculative, affective, and mnemonic practices in order to manage unseen and unknown water flows. However, I also contend that the difficulties of producing accurate knowledge of the grid are a result of the network's materiality. The possibility of knowing exactly how each pipe section, valve, and each water infrastructure that sprawls beneath and across Mexico City, its metropolitan area, and the basins that supply them and receive their wastewater, is not an attainable one. This is not exclusive to Mexico City, and indeed is a condition that can be observed in cities elsewhere in the Global North and South (Anand, 2015). In the face of such incommensurability, the forms of practical knowledge that are analysed in this chapter are necessary for water to be known, managed, and controlled by the state and its experts.

The practices workers deploy to manage the grid are always relational, as indeed other forms of expertise are (Carr, 2010). Workers' knowledge is shaped by diverse situated temporal,

spatial, material, and semiotic interactions with each other, with infrastructures, and with the city. In the first section of this chapter, I will analyse how workers' and engineers' memory bridges the gaps that exist between existing maps of the grid, often incomplete or inaccurate, and the material infrastructures that they must manage on their everyday work. In doing so, these state experts must not only know how the grid has changed over time. They also draw upon their knowledge of how the city has changed, and of how water flows through diverse infrastructures. They also deploy these understandings when calculating water flows and determining how certain water infrastructures should be managed. The fact that these forms of expertise are enacted beyond, and often against, paper trails (Hull, 2012; Mangset & Asdal, 2018) sheds light into how state work (Harney, 2002) is also one of situated improvisation and experimentation. Following the arguments presented in the previous chapter, here I further argue that indeed practical knowledge can be fundamental for purposes of statecraft, particularly in contexts of deepening and continuous austerity, and widespread disrepair.

Similarly to patchwork, these calculative, speculative, and mnemonic practices are shaped in the field through workers and engineers practical knowledge, and the particularities of the task at hand, as I will show in the first section. However, some of them have been routinized and become widespread. Such is the case of *vernacular metrics*, which are local measurements developed within SACMEX to understand and manage water flows and levels. These metrics are deployed constantly, and also gain meaningfulness through their relations with specific infrastructures and the manifold materialities of the city. It is precisely by virtue of being shaped by particular infrastructures and urban patterns and flows, these remain highly localised. Finally, other forms of practical knowledge are tasked with stabilising and fixing these fluid management techniques. They do so by translating vernacular metrics, speculating on water flows and levels, and eliminating unwanted water flows and improvised

solutions from official data. These tasks of purification (Latour, 1993) are themselves shaped by specific calculative, speculative, mnemonic, and affective practices that I analyse in the third section of this chapter. As an outcome of this labour of translation and purification, water is made into an object of management, state policy, and official knowledge.

Finally, I will also argue that, in deploying diverse forms of practical knowledge and affect to make nature into an object that can be known and controlled by the state, workers are making the state as a set of institutions that has, amongst other functions, those of managing and controlling urbanised water resources. Whether eliciting a map of the grid through memory, measuring water levels using vernacular metrics, or transforming these measurements in formal ones, workers are producing nature as an object of state control. These two processes are not only taking place simultaneously. Instead, they are always being developed together, as the making of the state implies the production of nature as an object of control and management (Parenti, 2014). This is an argument that has been made in relation to the control of water in Mexico (Aboites Aguilar, 1998; 2009; 2012), even if focusing mainly on structural processes of historical change. Studies carried out in different geographies show how water is indeed connected to the production of state power on both at a local and state-wide scale (Barnes, 2014; Swyngedouw, 2015), and how this is a process in need of constant maintenance (Barnes, 2017) and adaptation – a point made in the previous chapter. However, a specific analysis of the localised management practices that I will analyse here is so far missing. I claim that taking them into account is necessary to develop a better understanding of how infrastructures operate in the urban space, and how they are productive of nature and state as stable and enduring infrastructural relations and configurations.

BEYOND THE PRINT: MEMORY AND THE MAPPING OF THE WATER GRID

The material water grid in Mexico City far exceeds the plans, maps, and schemes that bureaucrats, engineers, and workers have at their disposal. There are several reasons behind this. It can be the case that maps are outdated, drawn up before a neighbourhood was built or expanded, whether legally or illegally. Others are non-existent, whether because they have been lost or they were never drafted. There are also those which are inexact, due to changes in the grid itself or to mistakes made when drawing them. Additionally, matter exceeds maps and other representations, even when these are precise. It certainly does so as water leaks or is tapped illegally. But these tools also fail to capture how water behaves in relation to air, pressure, and changes in the city's topography. In order to make these infrastructures, flows, and blockages known, workers, engineers and bureaucrats must fill the gaps that constitute formal representational versions of the water grid. They do so by deploying their memories, previous experiences, and practical and technical knowledge in relation to maps, the physical grid, and urban space.

I want to revisit a place that has been previously discussed in this dissertation. On Chapter 5, I analysed how informal elite control over space challenges the production and maintenance of state power through infrastructure. I argued this by exploring how some key water infrastructures have been encroached by Mexico City's wealthy elite in the upscale neighbourhood of Bosques de Las Lomas. I now want to draw attention to another process that can be traced from that very site. *Ingeniero* Obregón, a senior engineer in the area, was leading a group of workers and engineers in Bosques as they tried to find where a loss of water or pressure was, as some neighbours had been complaining recently. Obregón led by using the old, stained map I mentioned before. The map included the nearby aqueduct, the primary grid, and some aspects of the secondary grid. It was being used by Obregón to speculate where leaks or sudden losses of pressure might be happening. By tracing the flow

of water back from where the problem had been first reported, he reduced the places in which losses might be occurring to a handful. This led workers and engineers to sites in which they could not enter, as private control over space, its class and race-based logics, and its human and non-human enforces imposed themselves.

But something else was at play. After ruling out several potential chokepoints and leak sites, including those which workers could not easily access, Obregón was at a loss. He could no longer trace the flows of water through the grid. This was not because he was unable to read the map but because it was incomplete. Outdated, it did not include many primary and secondary lines built after the map was drafted. Where it showed nothing, sight perceived a dense mesh of concrete, metal, glass, dirt, and pavement. Houses, streets, electricity poles, trees, gardens, and, most certainly, underground pipes and cables, sprawled in front of us. Still, he and the workers that were there that day knew the area well. Even if not on the map, they could broadly tell where pipes crossed, and therefore could speculate where the problem might have been located. Obregón thought it could be in a series of water mains beneath a nearby main road. His knowledge of the system bridged the gap between the representational tool they had been using to navigate the site and the material layout of the pipes in the area.

We drove uphill, as Bosques is a neighbourhood traversed by numerous ravines. As we crossed one, the workers that I was inside the truck with told me that in that there were numerous mains there: a 32", a 10", and 6" pipe. They joked as they recalled how they had to fix a leak there once. The plot owners were extremely aggressive, and they had feared they might pull out a gun on them. They laughed it off, but I could sense that their worries were very much real. One of the workers, Alfredo, said that he thought the problem might be located in that same plot. As the pipes went abruptly down and uphill, he speculated that water might have been leaking or losing pressure in the lowest point of the ravine. We quickly

got off the truck, and Alfredo opened a valve box and made some adjustments. *Abuelo*, another worker in this team, asked the security guard of a nearby building to check if water was coming out with sufficient pressure after these manoeuvres were carried out. After a few minutes, he said there was no change. Alfredo returned the valve to its original position, and we drove towards the meeting point, where Obregón and the others were already waiting for us.

Above, we parked next to a main road. Obregón and some workers had already walked towards a flower stand. There was a valve box next to it. Obregón asked the workers to open the box. So they did, only to find it was covered with water. They unloaded a suction pump from one of the trucks in which we had arrived, and they started to drain the box. Meanwhile, another group surveyed the nearby mains, looking for leaking water. I went with this second team, not even 100 metres up the road, and found nothing. We walked back down and waited for a few minutes until the water was drained. One worker went inside the box, opened the discharge valve, but no water came out. Obregón was now certain that the problem could be reduced to a few blocks around us. If below water flowed when discharge valves were opened, and on top of the hill they did not, then there was a problem with pressure nearby. Obregón led a small group to survey a series of nearby infrastructures. He was quite convinced the problem was not there, but he had to discard all options.

After checking up on several valve boxes, abandoned measuring stations, and other nearby infrastructures, and not finding any leaks, and neither sufficient pressure, he was certain: the problem had to be downhill. He asked Alfredo, *Abuelo*, and the others to go back to where the pipes crossed the ravine. They opened the same valve box they had before. This time, instead of manipulating the valves, they started to disconnect two of them: a 2" one and a ½" one. I did not understand what was going on at first. I merely watched Alfredo go down the valve box as he started working. Obregón arrived there soon after and explained the

situation to me. Their deduction was that there was air trapped inside one of those two pipes, and that this was the reason behind the loss of pressure uphill. As this was quite probably the case, *Abuelo* and Jorge, the foreman, unloaded the suction pump again, as they expected water to spout out of the pipes as soon as they were fully disconnected. And so, it did. Water started coming out the 2" pipe intermittently, pushing out trapped air. This was the result of the nearby Zapote Water Deposit going dry a few days before. Air filled the pipes and formed a plug that was diminishing water pressure. A few minutes went by, and then water flowed normally. Alfredo closed the valve, connected the pipe again, opened the valve, and got on the back of the truck, with everyone already there, waiting for him.

I stayed behind with Obregón and we talked about what just happened. He told me that finding leaks, pressure losses, and other problems on the grid is very much a 'detective's job'. This requires specific skills and ways of knowing that are developed in the field, much like those that I analysed on the previous chapter under the concept of patchwork. In this specific case, Obregón's formal knowledge of water and air dynamics, and the design and operation of the grid were complemented both by his and the workers' practical knowledge of how the grid is built beyond the map, and what problems it has faced before. Here, expertise is carried out through the deployment of mnemonic practices and tools. As I heard frequently, a full map of the Mexico City water system exists only the memories of its workers. It is not centralised in one individual but scattered amongst many. It is not shared equally. Workers that have more experience on certain sectors on the city are usually those that are called upon when maps are incomplete, incorrect, or obsolete. These workers often are those at the bottom of the organisational chart; the ways in which they deploy these knowledge and memories can overturn momentarily formal and informal hierarchies in the field.

Furthermore, the way in which memory is elicited shows that it is not individual, self-contained expertise but rather a relational one. It comes into being through the interactions

between workers' experiences; the maps and plans they use to understand the grid; the shape of urban space, and the specific problems they are trying to solve at any given point. As a relational process, memory becomes a way to bringing that which was unknown into the calculative practices of state experts and workers. By digging into the past, workers surface underground infrastructural layouts, their changes over time, and previous instances of breakdown and trouble. This recalling is a process not only shaped by technical considerations. Numerous social and political practices also populate it. Alfredo's and *Abuelo's* recollections of the time in which they had to repair a leak in the ravine speaks of this. They had to deal with informal control over space; with similar racialized dynamics as the ones I explored in Chapter 5 when discussing the same Bosques space, and with a very tangible threat. Memory, as a tool deployed to understand how the water grid works and how it has changed over time, exceeds representations of said infrastructural networks in social, political, and material terms.

As a relational process, memory can also be useful to explore how the city is produced unequally. Workers' and engineers' past experiences are not only needed in Bosques. The water infrastructures of many neighbourhoods in Mexico City are either not mapped or mapped in an inaccurate or incomplete way. The fact that, in Bosques, Obregón, Alfredo, *Abuelo*, and the others could recall where pipes, valves, potential chokepoints, and previous breakdowns had happened shows that it is a well-established, wealthy, and well-connected neighbourhood. Whether they were built without using plans, or if the plans were lost at a later point, it is clear that the pipes and valves that enable and regulate supply there were built following the rules of formal hydraulic engineering knowledge. This is not the case elsewhere in the city, and particularly in the marginalised, self-built peripheries of Mexico City. There, memory often fails to be a bridging tool between the materiality of informal and

precarious water infrastructures as these are always shifting and are rarely surveyed and maintained.

Around 18 kilometres southwest from Bosques, several settlers have built precarious houses in the hilly woods near the town of La Pila, in the border with the state of Mexico. I visited that area with a work team on the very same day we went to Bosques. Our task was to find a spring and unclog the catchment that had been installed there. It was the early hours of the morning, and the woods were a world away from the dense road traffic that we encountered on the way there. Asphalt suddenly became dirt as the road entered the lush forest that still covers that area of Mexico City. The truck made its way into the woods slowly; suddenly, it could not move any further. It was spring and it had been raining, turning roads into small streams flowing down the hill. We got off the truck and started walking uphill. Trees as tall as buildings, which barely let any light in, deep green shrubs, and the songs of hundreds of birds had replaced the honking and shouting of the street. We walked in relative silence for a few minutes. When we started talking again, I asked the guys if they visited that area often. Most of them had never been there – and neither had I. Only one worker said he remembered being up there around 7 years before.

We kept walking until we found a clearing. We stopped in silence again, as we could hear a sound that resembled water nearby. Unable to use memory as the site was remote, little visited, and therefore completely unknown to most workers, we relied instead on our senses. After a few seconds someone said that the sound was not water but the noises coming from the high-tension wires above us. Satisfied with that explanation, we kept walking. We passed a small cluster of self-built cabins, no more than 5. They were made of wood, and had laminated roofs, covered with plasticised banners that advertised local politicians. I could also see some satellite television antennas, but I could not confirm they were actually

connected. Coming down from the hill were several hoses, carrying the water from the nearby springs. We were close.

We tried to walk further up but could not. The hillside was too steep, and no one knew a suitable road. Jorge, the foreman, called the truck driver and soon he managed to pick us up, using an alternative route he had found. He drove us a bit further up until the road disappeared. We got off again and walked for around 20 minutes until we found the pipes that came from the local springs. We followed it for at least 45 minutes but could not find the site. We grew increasingly tired, and we decided to rest for a bit. It was then when the foreman received a call from Obregón telling him to stop doing whatever he was on to, and to head to Bosques as soon as possible. Before doing that, they took a photograph of me standing next to the pipes. They would later use it as a proof that we had indeed been there.

Certainly, the impossibility of finding this blockage, or the spring for that matter, far exceeds the question of state workers' memory. Obregón call, which demanded the work team's attention elsewhere, shows how repair and maintenance priorities are shaped by spatial inequalities in the city. The pressure (Anand, 2011) that wealthy inhabitants of Bosques were exerting on SACMEX required the labour and knowledge of dozens of workers. In the outskirts of Mexico City, marginalised inhabitants are unable to engage in this kind of relationship with the state and its experts. Instead, what exists is a space in which neither maps nor memory are unable to make space and water flows intelligible. The fact that these workers had not been there for over 7 years indicates that this neglect is systematic, and only questioned when problems impact communities that have the possibility of putting pressure on SACMEX. Furthermore, this space lacks the spatial order that characterises the formal, concrete and steel city. Yet, it was in this space, devoid of maps and surveillance, where the possibility of surviving in the city was made by local settlers. By looking at the hoses that tapped on the pipes and unseen springs, it is clear that these settlers have mapped

those woods, even if without drafting plans. Even when the gap between formal representations of the system and informal ways of knowing it are bridged outside the state, there seems to be a role for memory and the practical knowledge that is developed through everyday interactions with infrastructure.

VERNACULAR METRICS

An antenna rises over a water deposit. A number of cables are connected to it, travel across the top surface, and then go inside the deposit. They have been installed there to measure water levels remotely, but many are not functioning. If on the one side they are connected to the antenna, on the other they are attached to nothing. In many water infrastructures across Mexico City, telemetry systems await the final influx of money to be fully installed. This is the technological solution that has been promised as a replacement of the on-site operators that once monitored diverse sites across the System. These workers have been laid off amidst deepening budgetary cuts in the past years. A technological fix, the telemetry system, has not been rolled out completely due to the same reason and, many speculated, widespread corruption. Waiting for a technological solution that heralds a future that is constantly being deferred (Harvey, 2018), workers and engineers continue to monitor and manage water levels using vernacular metrics that are widespread across SACMEX.

Water levels in deposits and distribution chambers are measured commonly in terms of 'steps' (*escalones*). They refer to the number of steps of the fixed ladders that are normally installed within these infrastructures that water is covering at any given moment in time. Being defined in relation to the volume of water a particular infrastructure can hold, steps, as a metric, is not a universal measuring device. That is: it does not mean the same in each infrastructure in which it is deployed to make sense of how much water there is. It is therefore a relational metric, which is defined by the material characteristics of diverse

deposits, but that also calls for specific forms of knowledge from workers and engineers. When interpreting if water is at a desired level, these experts are not only drawing upon their understandings of any particular infrastructure. They are also bringing into their calculation the households, offices, and other buildings that these deposits or distribution chambers supply. When determining if a certain number of steps represents an ideal situation, or one of lack or excess, they do so by taking into account which places this water is supposed to be supplying.

I came across these measurements constantly but gained a better grasp of their logic when accompanying *ingeniero* Maza and his second-in-command, Teacher, when surveying and managing infrastructures in west Mexico City. Maza was a mid-level engineer at SACMEX's West Office. Originally from the southern state of Oaxaca, Maza was a quiet, mild-mannered man on his late 50s, who oversaw around eight work teams in the area. His functions, as those of other engineers in SACMEX, also included supervising infrastructures on-site, drafting reports to send to the central SACMEX offices, dealing with a number of emergencies, and liaising with other governmental and private institutions when carrying out repairs or maintenance operations in specific areas of his jurisdiction. Maza heavily relied on his second-in-command, Teacher. He was slightly older than Maza, originally from Mexico City, and wore high prescription glasses. It was because of the glasses and the fact that he always carried a little notebook with him that he had gained his nickname. Teacher usually dealt with workers, as Maza had somewhat of estranged relationship with the teams under his command, and with SACMEX in general.

A regular morning started with Teacher and Maza in the latter's office. The two of them went through the work orders for the day. Some of them had been programmed in advance, and others were usually communicated to them urgently through instant messaging mobile applications by one of their superiors. They matched tasks with teams according to city areas

and sectors, which Teacher then distributed as a printed list to the foreman of each team. By 8.30 am, all work teams were gone. Then Maza, Teacher, José, Maza's driver, and I left to survey some of the main infrastructures under his management. On many occasions, the decision of which sites to visit were shaped by a desire to show me how the system worked, and where relevant functions were performed. We visited numerous deposits, pumping stations, and aqueduct sections in the hilly areas that characterise west Mexico City. Still, a significant number of our trips included surveying infrastructures that had been presenting problems recently.

One of such places was the Ponderosa Deposit, located near the upscale Santa Fe area. Santa Fe is a privately-developed neighbourhood which benefited from diverse fiscal and urban policies, enacted by successive local governments, and built from 1989 onwards, with a strong impetus during the 2000s (Pradilla Cobos, 2004). The project included the development of a large mall, of high-rise, luxury offices, and of numerous gated communities designed for an urban elite. Built through enormous investments on real estate and urban infrastructure on a site previously occupied by a landfill and by informal settlements, Santa Fe has become almost synonymous with the production of an increasingly fractioned urban space, dominated by private actors and the logics of capital accumulation (Valenzuela, 2007; 2013; Moreno Carrasco, 2008; Delgadillo Polanco, 2012). Surrounding this urban enclave (Caldeira, 2000) there still are numerous self-built neighbourhoods, *colonias populares*, which, even when connected to urban infrastructures, experience numerous lacks and shortages. The Ponderosa Deposit is located in one of these *colonias*, but it services Santa Fe, in particular the area around the private ABC Hospital. Built on the high side of a ravine, it is a site in which the inequalities that make up Santa Fe are highly visible.

The Ponderosa experienced problems during most of my fieldwork period. It was constantly emptying or overflowing, and Maza and Teacher had to make their way there repeatedly to

patchily solve this issue, as it was one of such places in which an on-site operator had once been present but had been laid off, and where an incomplete telemetry system had been installed. Desired water levels at the Ponderosa Deposit were defined as being between 12 and 13 steps. There, desirability was primarily determined by the needs and wants of the private hospital, the luxury apartments, and the office buildings the deposit supplies. A second set of preoccupations were those of losing grid efficiency through water overflow, although these seemed to come second to the imperative of keeping water flowing. Both Maza and Teacher emphasised many times that their main concern was keeping the deposit levels constant, often prompted by the pressure neighbours exerted through their contacts with senior engineers in SACMEX. The fact that this flow was monitored and enabled by a mid-level engineer shows the importance the site had, one that was shaped by the very places it was connected to, and the users it serviced.

Whether overflowing or lacking, water is controlled by the manipulation of valves. As in relation to water levels and steps, the regulation of water flows is expressed in another vernacular metric: valve turns (*vuelatas*). This refers to the amount of times a given valve must be turned in order to allow for a desired quantity of water to flow through it. As with steps, turns are a highly localised measurement. They depend on the width of the pipes any valve regulates, on the volume of water the deposit they feeds can hold, and is related not only to the infrastructure to which it is directly connected, but also to its position within the grid. In knowing how many times a valve should be turned, engineers and workers are again drawing upon their longstanding engagements with the system, and on their reading of the city that surrounds them. In the case of the Ponderosa, the imperative of supplying the wealthy enclave mattered as much as knowing exactly how many turns were necessary to increase or decrease water supply, both at the deposit and further upstream

One particular day, levels at the Ponderosa deposit were dropping alarmingly fast. Maza, Teacher, José, and I got there as soon as we could. When we arrived, we quickly made our way up to the top of the deposit. Water barely covered the tenth step, and nearby buildings were already reporting pressure losses. Maza called the operator that was in charge during that shift of monitoring and controlling the deposit that feeds the Ponderosa: the Tamaulipas. He picked up and said he was at home, ill. Maza then called the operator that was supposed to be resting. He was indeed at the deposit. Maza asked him to open a valve a bit more but he did not specify how much exactly. The operator did so. We waited for a bit, but nothing happened, and Maza decided we had to go even further upstream, to the Cruz Manca station. There, levels were also low, particularly in the distribution chamber that fed the Tamaulipas deposit. Maza, Teacher and I walked behind the chamber, where the valves that control how much water flowed into it were located. Maza and Teacher deliberated for a few minutes and decided that three turns to the valve should be enough to increase the levels at the chamber that fed into the Tamaulipas deposit.

We waited around 20 minutes and then checked the chamber again. Water was at an even lower level. Their adjustment had not worked according to their expectations. They hypothesised that the problem might be in the main distribution chamber in Cruz Manca, a large facility that feeds numerous pumps and deposits. We climbed on top of the building, where water levels were low as well. The next course of action was to close the discharge valves, used to regulate the Cruz Manca distribution chamber in case of overflow. This time, I joined Maza and Teacher, as both valves were extremely tight and are hard to operate. We managed to close one a bit, managing to turn it one and a half times. They were unclear if this was enough, but it would have to do. The second valve would not even give in half a turn. Still, we tried to close it as much as possible, and were satisfied when it moved slightly.

Now, we had to wait to see any meaningful changes. We went out for a bite in a *fonda*, where we had *chicharron en salsa verde* with handmade *tortillas* and fruit water.

After lunch, we waited for a long time at the station. I played with the station's guard dog, whilst José took a nap, and Teacher and Maza chatted about playing *frontón*, also known as Basque ball – a sport Maza played far too often, according to many of the workers in the office he directed. After an hour or so, Maza asked Teacher and me to go back to the Ponderosa to see if their movements had had any effect. They had not, or at least not yet. Water levels were even lower, down to the seventh step. Teacher and I stayed on top of the deposit for around half an hour, observing patiently and waiting for water levels to change. Perhaps another hour went by. I did not notice much of a change, but Teacher was certain that the deposit was well on its way to recovery. He called Maza and told him that their movements had worked. It was around 3 p.m., and he calculated that by 5 p.m. levels would be back to normal. I kept looking but still could not see the change. A keen eye for noticing how flows respond to valve movements is necessary to understand how water levels work and change, and how water infrastructures are managed in SACMEX.

Turn is not only a vernacular, but it is also an adaptive metric. Even if instructions on how to operate certain valves, deposits, distribution chambers, and other infrastructures exist, they often do not reflect the conditions that engineers and workers face on a day to day basis. Infrastructures rust, corrode, and wear and tear over time. Where one turn was sufficient before, now one and a half might be called for. I saw this kind of adaptation at play numerous times. Workers who had a feel for any particular valve, and had seen how it had been behaving recently, were able to correct how others attempted to regulate water flow – a practice that allows the infrastructures that manage and enable water supply in Mexico City to function. Additionally, changes in material conditions certainly exceed infrastructural decay. Urban growth puts cumulative pressure on infrastructures across the city. Increasing

demand requires not only more water but also an adaptation of the ways in which crucial infrastructures are managed. Engineers and workers therefore have to translate spatial changes into the practical operations through which they manage infrastructures. Something as simple as knowing if a certain valve requires an additional half turn denotes how these understandings are shaped through infrastructures, urban space, and the everyday practices of workers and engineers.

The specificity of steps and turns as metrics means that their precision is highly localised, even if their status as a metric is widespread in SACMEX. For them to be meaningful, they require that those who are observing a specific deposit or manipulating a particular valve, as well those who are receiving information related to it in central offices via radio, share a common knowledge of the grid and the city in relation to it. Here I have shown how these shared understandings are deployed in practice, and how they are shaped by water flows, infrastructure's materiality, and situated readings of the city. In addition to this, these vernacular metrics are necessary in making water knowable as an object of state control. Through this shared language, experts bring water into the calculative gaze and managing hand of the state, even if constantly sieged by subterranean processes of infrastructural decay, and the increasingly complex and rapid pace of urban change in Mexico City.

MEASURING, CONTROLLING, TRANSLATING: EXPERTISE AND THE MAKING OF STATE WATER

Vernacular metrics undergo a process of translation into formal ones in order to overcome their boundedness. This is necessary if they are to be used beyond the confines of the highly localised management activities I analysed in the previous section. Translation allows vernacular metrics to be made into the formal ones, cubic metres and litres per second, that compose the official data that SACMEX deploys to know, manage, and represent the system

in a larger, city-wide scale. The outcome of this process are seemingly precise numbers, which appear to give direct access to how water flows within the grid. However, ethnographic attention to how these numbers are produced shows that both precision and unmediated knowledge are not characteristic of system-wide statistics and data. Instead, the numbers being produced in SACMEX are mediated by several tools, practices, and attitudes, all characterised by the deployment of calculation, speculation, memory, and affect. Through documents, routinized communications between staff, and the continuous production of data, workers are able to produce water as a measurable flow that can come under control of the state. In this doing not only numbers are made, but also the very capacity of the state to know how water is supplied, and to produce its power as producer and manager of natural resources, and the lives that are enabled through them.

In what follows, I will develop these arguments by looking in-depth at the work of two experts: Miguel and Santiago. Miguel was a radio operator in SACMEX West Office. His job was to control the operation of pumps, deposits, and distribution chambers to guarantee continuous supply to the area under his watch. He was in charge of the morning shift, arguably the busiest one, as it is then when most water is consumed in households in residential areas of the city. His job was not only one of remote control of water infrastructure operation. He was also in charge of reporting data on water levels across the West Office. To carry out these tasks, Miguel relied not only on the data that other in-site operators transmitted to him, but also on the operators themselves. The relations of trust and mistrust that Miguel had established were crucial for him to determine which quantities were reliable and which were not. Moreover, this affect – trust – was not only mediated by his emotional relations with other workers. As I will show, they were also being produced by a monetary exchange, which also allowed for the purchase of materials through which measurement is possible. In the face of budgetary cuts, the payments that are made to

Miguel allow not only for him to survive, but for SACMEX to fulfil its role as a water management utility.

The second worker, Santiago, was a draughtsman-cum-statistician. When he was not drafting plans – an activity that had become less and less frequent – he was in charge of calculating average flows, and of representing them schematically. He was also in charge of translating vernacular metrics to formal ones for the purposes of compiling data that was used to draft official reports made by SACMEX. In both cases, Santiago depended on a number of tools and on his memory and practical knowledge of the grid and its historical operation. As I will show in the section focused on his labour, Santiago's memory allowed for the gaps in measurement to be filled through calculation and speculation. When data was missing, Santiago relied on his knowledge of the system, gained through decades of work in the same position. In doing this, Santiago was constantly disposing of the imprecisions, improvisations, affects, and incommensurability that characterise the grid. His was, in many ways, a task of purification (Latour, 1993) that had as a goal the production of a fixed, stable grid, and of measurable, knowable water. As Miguel's, his labour is necessary for the production of state power over urban space through the management of water flows, thus allowing for the making, reproduction and adaptation of numerous socio-material processes and infrastructural configurations.

AFFECT AND CALCULATION: OPERATING THE GRID FROM THE RADIO STATION

'Are you gonna get us computers?' González asked me when as soon as I stepped into the radio office. It was around 7 am on a cold Tuesday in October, and I was there to see how the radio operators controlled the grid from a distance. González was in charge of the night shift, and should be replaced at 7 sharp by Miguel, who was not there yet. He was sitting there with Teacher and another man, whose name I did not write down. They guided me through the contents of the room. Next to the radio, there were a series of wooden

clipboards. Each had a number of pages where the names of all the deposits, measuring sites, pumping stations, and distribution chambers in the area were listed, and space to register their water levels was provided. In addition to keeping track of water levels and flow, the radio operator also coordinated how valves were operated across the West Office. For Cortés, that room was ‘the neuralgic centre of the System’.

Miguel arrived a bit later, around 7.15 am. He looked upset. He sat down in the chair and started asking for data. He grew increasingly angry. Banging the clipboards, and shouting over the radio, he did not acknowledge my presence at all. Some of the numbers annoyed him particularly. He listened to them and wrote them down across different pieces of paper. I did not understand what was going on. The reason for his anger, or even why some numbers went in a piece of paper and others in a different one, was completely beyond me. When he was done with a certain clipboard, he would throw it away. The room became increasingly noisy, filled with his stress and anger. González and the others left without making too much noise. As Miguel kept demanding more numbers, he had breakfast: a coffee and a piece of pastry, a *mantecada*. This went on for around 20 minutes. During that time, he did not say a word to me. Finally, he spoke. ‘Are you here to keep an eye on me, then?’ he asked, mockingly. I was taken aback but quickly responded by saying I only wanted to learn.

Miguel went silent again before asking for more numbers over the radio. After a while, he started talking to me. He told me what the work was about. From that spot, he asked for data across the System. This helped him know how water was flowing: ‘is there shortage, overflow, trouble?’ he asked rhetorically. Numbers allowed him to know all this. As he kept explaining, he told me he was sorry for his early morning anger. The reason behind it, he said, was simple. There is a deposit called Palo Alto, where an operator close to a union chief worked on Mondays’ and Saturdays’. At night, and still during his shift, he simply closed the valves to avoid overflow. This inevitably led to recurrent shortages on Tuesday and Sunday

mornings in the parts of Santa Fe that were supplied by that facility. He stopped short from calling for this operator's destitution but not by much. He certainly did not appreciate the extra work that he had to do on those days, and he was more than happy to discuss his displeasure with me, and indeed with others that walked into the office over the course of the many mornings that I observed Miguel work. For Miguel, this attitude reflected a complete disregard for the correct functioning of the System, which could be greatly affected by the negligence of one person.

This is not the only instance in which individualised interactions might alter the operation of the grid. As Miguel later reflected, he was constantly facing the possibility of receiving false information through the radio. He defined his labour as 'working with lies', drawing attention to the fact that he was unable to confirm if the data given to him was accurate or reflecting the situation on any given infrastructure. Being bound to his office, and without functioning telemetry equipment, he was forced to rely on the operators. Whilst no one was free of suspicion, as anyone could be reporting false or inaccurate data to conceal the fact that they were not present at the infrastructure they should be manning, some people were more deserving of his trust than others. Trust is relevant here because this is the affect that mediates the purported accuracy of measured data. Miguel indicated that trust was rooted on the precision of information across time in relation to the task of controlling water flows and keeping the city taps flowing. That is: if a worker systematically provides data which is useful to understand how water is flowing, thus allowing to control the grid efficiently, he and his information become more trustworthy.

But still more elements are at play. Whilst asking for data, Miguel made a couple of calls that showed how trust was also a gendered affect. At least two deposits had female operators, and there Miguel shifted from being a no-nonsense, tough, loud man, to one that was over performing the part of a soft-spoken, charming suitor. He took longer than usual in these

calls, talking sweet to the unseen women, and taking their data face-value. Whilst there is undoubtedly much more to say about the performances of gender in SACMEX, here I just want to highlight that, for Miguel, trust is not only something that is gained only through accurate information given through time, but also an attitude that can stem from gendered interactions. In any case, trust is an affect and practice that bridges the gap between that which remains unknown to radio operators and the flows of water in distant deposits and pumping stations. Through trust, numbers gain solidity and become part of the task of managing the System. As these moments highlight, this task is one that routinely exceeds the logics of calculation and measurement that are presupposed to lie behind numerical data.

Moreover, trust is relevant beyond the task of keeping track of water flows in paper sheets, and through them keeping snapshots of the status of the grid at different moments in time. As Miguel kept calling different sites throughout the morning, I noticed how he not only wrote down water levels but also gave instructions to different operators. He heard a number, and after being assessed as trustworthy, he decided on a course of action. He, for example, asked operators to close a discharge valve 40 turns, or to open a different one 25 turns. He also chastised those operators who 'owed him water', as a result of an error in their operational practices. When the operator was not trustworthy, like in Palo Alto, he confronted them using data gathered from surrounding infrastructures, which allowed him to know if a number was inaccurate. Throughout these exchanges, it was clear that he knew almost by heart what to do, as he did not take too much time to reflect on the commands given. Reading numbers as desired or expected water levels or flow rates, he was able to manage the system from a distance. The ideal functioning of the water grid was not stemming from a manual but firmly rooted in Miguel's way of managing the system from afar. Operators trusted Miguel's knowledge, and acted accordingly.

As the day went on, people started making their way to Miguel's office. They were deposit operators who had finished their shifts. Many came inside and talked to Miguel about numerous grievances. They complained about malfunctioning equipment, delayed repair works, or the need for new office furniture. Miguel duly took notes and guaranteed the operators he would look into it. Others showed up just for a chat about numerous topics, from gossip about other colleagues to sports and politics. Almost all of them gave Miguel money before leaving, between \$20 and \$50 pesos (around £1 or £2). He put the money on his pocket, and never said a word about it. The exchange had all the markings of a routine situation – something I would indeed confirm in later occasions. Miguel, perhaps responding to my puzzled look, explained that the money was in part a payment for bringing up their issues to management. As part of his job, Miguel got a phone call directly from SACMEX Director of Operations every morning to check how water was flowing. This was the proudest moment for him. The one episode in which the relevance of his labour was made patent, and one source of the trust many workers had in him not only when asking for better working conditions, but also when receiving orders on how to operate the many infrastructures that regulate water flow in west Mexico City.

Miguel's account of what the money was for was not inaccurate, but it certainly was incomplete. This monetary exchange is also relevant in at least two other ways in the production of data regarding water flows and levels in the System. One is material and concerns the payment that goes into photocopying the forms that Miguel and the other radio operators must fill out. As SACMEX is systematically underfunded, these basic functions are transferred from the administrative structure to the administrative workers themselves. The performance of this basic function of water management on behalf of the state requires the participation of bureaucrats, a task that was often discussed in critical ways by them, but carried out nevertheless, being perceived as necessary for the survival of the System. This

transference of basic functions of infrastructure management, maintenance, repair, and even file-keeping and archiving is commonplace in SACMEX. In these other instances the progressive and sustained disinvestment from the System⁵¹ is also a main driver. Without the workers' funding, it would be impossible to carry out some the main functions of state water management.

The other way in which money becomes intertwined with the task of capturing measurement data concerns again trust. I learned that many of those who pay do so as a way to guarantee that the radio operators will cover their backs when they are absent from their positions. Miguel and the other workers in that position are often informed beforehand of future absences. Radio operators know when a specific deposit operator might be gone, and they might have made arrangements related to valve openings and expected water levels. Certainly, not all infrastructures can be left without surveillance for long periods of time. Equally, not all workers seem to be willing to participate in this informal economy. Both factors might explain Miguel's animosity towards the Palo Alto operator. Be that as it may, it is clear that Miguel's trust – and indeed that of other radio operators – is not always exempt from the price mechanism. When this occurs, the relevant radio operator assumes and inputs a value for the missing data, taking into account how much water is flowing in the rest of the system, and how a specific infrastructure has been behaving during the past few days or weeks. Memory and calculation come into play. These are relevant beyond the radio station and are part of how other data regarding water flows is calculated in SACMEX.

THE TASK OF TRANSLATION: FROM VERNACULAR TO UNIVERSAL METRICS

⁵¹ This tendency has been reverted in 2019, as the new Mexico City government has increased SACMEX budget with a clear mandate of improving repair and maintenance. It would indeed be relevant to research how this change might impact the practices documented in this dissertation.

A few days after meeting Miguel for the first time, I was introduced to Santiago. He worked in a tiny corner office, packed with maps, folders, and hundreds of loose pieces of paper. He was officially a draughtsman, but I learned quickly that his duties went far beyond that. Apart from drawing the maps that were called for occasionally when repairing or maintaining particularly relevant infrastructures⁵², he was also in charge of calculating average flows, representing them schematically, and translating vernacular metrics into data that could be used beyond the confines of the West Office. In practice, this latter set of tasks were his main concern. The first half of his day, from around 8 am to 1 pm, was used to produce these schemes, and carry out the required calculations. In the dimly lit office, he sat in the drawing board further away from the entrance, the other one available being reserved to a female engineer, Susana, who was never there during the mornings, and only occasionally during the afternoons and evenings.

I took Susana's desk for two months as I learnt how to properly fill the charts and schemes, and also how the vernacular metrics of steps was translated into cubic metres. In doing both, Santiago relied on his practical knowledge, particularly in both memory and deduction, as well as in material tools, such as conversion charts, which were crucial in making water flows knowable. In what follows, I will analyse the task of filling out schematic representations of the grid. I will show how these are means through which an idea water grid is made material and official. In these documents, and through Santiago's labour, the many leaks, illegal takes, and unregistered flows that take place in the city are erased, presenting instead an image in which the System works according to an ideal or desired version of the grid. State control over water is made through this task of purification, and through the documents in which

⁵² Indeed, this is a topic that requires more explanation. Santiago's maps were not used in every single repair but usually in those that were particularly contentious due to the involvement of either other governmental bodies or particularly well-organised neighbourhood associations. The process of drafting these maps is also characterised by improvisation, as labour has been argued to work through infrastructures throughout this dissertation.

this ideal version is made material, even if it remains precarious and challenged in the flows of water through infrastructures across Mexico City.

Santiago's representation of the grid starts with an empty document, similar to the one shown in Figure 23. The main difference between the one showed here and the one Santiago uses is that the latter has designed spaces to write down the water levels or flows of each infrastructure. Dozens of little boxes lay empty, waiting for Santiago to make them meaningful for purposes of management and statecraft through his labour. Every day starts the same way. Santiago begins by filling out certain quantities out of memory. What could be easily took for an arbitrary action is certainly not so. These numbers are, according to him, 'the sites in which water levels are, or should be, constant'. That is: due to their position within the grid, both in terms of how water flows and where they are located in the city, certain infrastructures are assumed to have roughly the same average amount of water daily. These sites are normally large infrastructures that supply not final users but smaller deposits. Moreover, these sites are crucial for the schematic representation itself. By materialising a wishful certainty that water levels are indeed constant, Santiago creates fixed points that underpin the rest of the calculations he has to carry out.

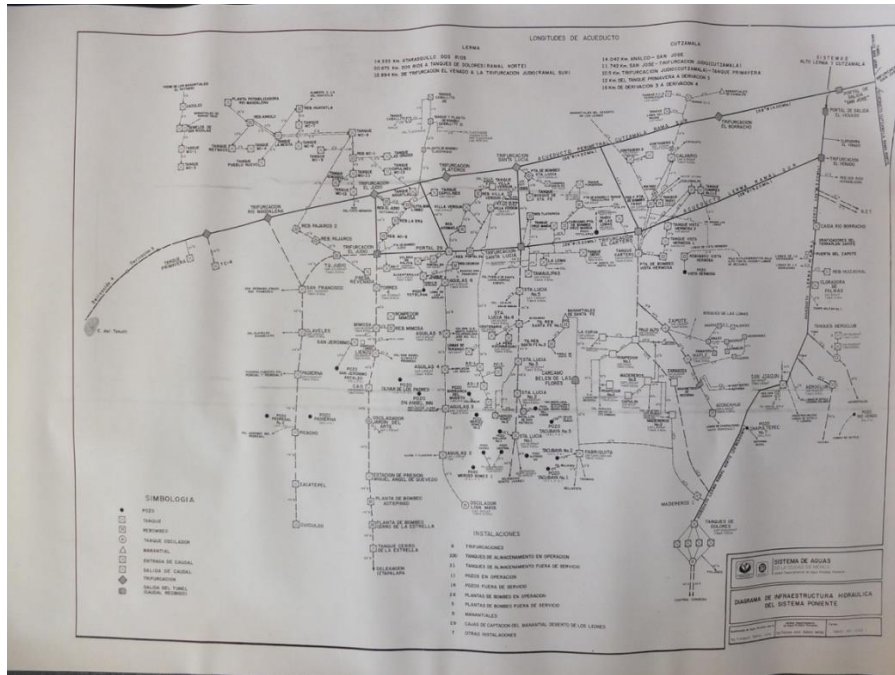


FIGURE 23. A SCHEMATIC REPRESENTATION OF THE WESTERN MEXICO CITY WATER GRID

These anchor points are not known through a direct observation of the sites to which they correspond. Instead, they are assumed by Santiago through the interplay of memory and regularity. Akin to Miguel’s measurements, Santiago can trust that some infrastructures will be kept supplied in a consistent way. He also expects these infrastructures to function properly, as any leak, excessive discharge or overflow would jeopardise not only any given quantity but the whole calculation. Relying on both workers and infrastructures, Santiago then uses his memory and knowledge of the grid to create a site of stability, one that underpins the representations of the network that circulate beyond his office. Crucially, these representational documents and tools are not fully based on a measurable set of quantities, but on assumptions about ideal states. These expectations are fundamental in the task of managing the Lerma. Through them, otherwise unknown water flows and levels are brought under the gaze of the state and are made an object of management. At the same time, they are deployed to produce the image of a bureaucratic corpus that is able to oversee

a sprawling system, yet this is one that can only be made so if uncertainties are removed from representation.

The following step furthers this logic of stabilisation through purification. It consists of writing in the data that has been provided by the central radio operators. These numbers are not the ones that Miguel, Cortés or any other operator provides. Instead, they are a daily average, which already reduces variations in water flows and levels throughout the day. Averages erase not only fluctuations but also the problems that, for example, Miguel faces when the Palo Alto operator leaves the valves closed for the night. Also absent from these numbers are those that have been filled by radio operators as a result of a specific payment, being themselves not the result of measurements, but of calculations based on history and memory. This is another instance where water flows are stabilised by removing those practices that make their variability and imprecisions visible. In making manageable the unknown – flows, levels, leaks – these practices are simultaneously concealing those processes that threaten the ideal version of the grid and the System. Trust, monetary exchange, calculations and assumptions are hidden under the straightforwardness of a single number.

By the time he has finished these two tasks, Santiago has an almost complete image of how water is supposed to be flowing in the grid. There are, however, a number of infrastructures in which water levels remain unknown. These pose a particular problem, as Santiago has neither the certainty of constant water levels, nor the straightforward knowledge that comes from a number that has been previously transmitted by a radio operator. Here he is facing truly what is unknown, at least in terms of empirical confirmations. To fill this data, he uses both calculation and memory, underpinned on three sets of numbers. Those he has assumed remain constant; those provided by the radio operators, and one more: the total of water that entered Mexico City from the Lerma and the Cutzamala systems. This number is

measured at the El Borracho station, where the combined flows of water enter the city and its metropolitan area. The specific amount of water that enters the city changes, depending on pumping rates, consumption levels, rainfalls, leaks, and other unseen technical, social, political, and natural processes. For the sake of this chapter, let us stick to one of the numbers Santiago used whilst I was working with him: 14,010 litres per second. This number is the main reference point. The total water in the grid has to match this number. No leaks, no illegal takes, no pressure issues, no water unaccounted for. An ideal system that exists solely on paper.

The logic Santiago follows is both spatially and hydraulically shaped. Water flows through diverse branch lines. In each one, some numbers are available, and others are missing. Those available normally correspond to larger infrastructures, from which water is distributed to smaller sites before making its way to households, offices, and commercial premises. In some cases, the calculation is quite simple. Let us imagine a deposit that distributes water to three smaller ones. Santiago knows that, out of those three, two are significantly smaller. He also knows where each one is located and has a clear memory of how much these have been storing in the past few months, or even years. He knows that the imaginary area is one in which water consumption is high, being a luxury development in western Mexico City, so water supply will be constant. This leads him to assume a number that can satisfy demand, that can correspond to supply, and that is in accordance to the historical behaviour of the system. Other cases are less straightforward, but all of them follow a logic of equilibrium between supply and demand; are informed by assumptions of the things not represented in the diagrams and schemes; and underpinned by measured or assumed data.

As I became an expected presence in Santiago's office, I started helping out with these tasks. One of them was assisting him to corroborate that the amount that was present in each branch corresponded to the water that was flowing in, and that, at the same time, the sum

of all quantities corresponded to the water that had entered the system: 14,010 l/s. Often the addition failed. We had to trace back our steps and deduce where a quantity might be lower or higher than stated. Santiago would say something like: 'increase fifty cubic metres in that deposit'. I would ask why, and he would say that he assumed that the mistake was there as that area was normally well supplied, and that it made more sense that the error was there instead of elsewhere in the system. Whilst there is undoubtedly a degree of arbitrariness to this process, it is also clear that it is driven by Santiago's profound practical knowledge, gathered throughout his long tenure as the office's statistician.

After getting the correct number – an equivalence between the water flowed measured at the top of the system and the sum of the amounts reported for each deposit and station – Santiago considered the job done. He left to me the task of copying the final numbers to a new diagram, where crossed out levels and messy calculations were left out. The final version of the map materialised the imagined closeness of the grid, where unwanted flows do not exist, despite all material testimonies of the contrary. The 42% that is lost to leaks happens always elsewhere. The problems that Obregón, Maza, Teacher, Alfredo, and many more workers deal with on a daily basis are left outside of these papers. Mnemonic, affective, calculative, and speculative techniques and practices are not traceable in paper. The ways in which the unknown is elicited are obscured. This is how official state water is made, and how stable infrastructural configurations and their representations are produced and distributed.

CONCLUSION

In this chapter, I have shown how the task of managing the Lerma System requires to turn unseen and unknown flows of water into measurable quantities, stable numbers, and fixable problems. In order to do so, I argued that diverse forms of practical knowledge are called for, deployed through memory, calculation, and speculation. These three forms of knowing the

System are distributed unequally both across the workforce and are relationally constructed through urban materialities. Just as certain workers know the grid better, usually as a result of their longstanding engagements with the field, some areas of the city are particularly amenable to these knowledges. This, I suggest, is related to deep-seated urban inequalities. For example: memory is often unable to bridge the gaps between mapped representations of the water network in spaces where informal infrastructures and scarce state surveillance predominate, as the case of the settlements in La Pila shows. This situation stands in sharp contrast to the upscale neighbourhood of Bosques, where workers' memories and deductive capacities, made in relation to a planned, even if unmapped, grid were deployed to make an unseen air bubble known, allowing for water flow to be restored.

However, memory is not sufficient to bring water into being as an object of state control. Other ways of knowing are called upon. Central amongst them are vernacular metrics, which allow workers to understand, manage, and calculate water levels and flows. These vernacular metrics, steps in relation to water levels, and valve turns in relation to water flows, are common across SACMEX. Despite this commonality, I have also shown that these vernacular metrics are effective only in a highly localised way. Gaining a stable meaning only in relation to specific infrastructures, steps and turns require not only understanding that these metrics refer to certain states of water, but also knowing which particular infrastructures they refer to. This results in vernacular metrics that cannot travel far across the SACMEX bureaucracy. The need to operate infrastructures at a broader scale, as well as the task of producing water statistics and measurements, means that these ways of measuring have to be translated into universal metrics. A different set of workers, in particular radio operators and local statisticians, convert steps and turns into cubic metres and litres per second, and draft idealised versions of the grid. These documents are

meaningful beyond the confines of vernacular metrics, becoming the basis through which senior officials within SACMEX, and beyond, understand the water grid.

These numbers are not an identical reflection of water flows and levels in material infrastructures. The translation from vernacular metrics to formal, universal ones is characterised by an interplay of assumptions, deductions, affects, and is also shaped by local economies. When discussing how Santiago and Miguel annotate the supposedly existing water levels and flows in different SACMEX infrastructures, I showed how they have to rely on their memories and deductive knowledge to make unseen water knowable. As information from particular infrastructures is either incomplete, unavailable or inaccurate, these workers have to deploy a number of assumptions that make possible mapping the grid. In producing this information, workers also rely on affective relationships, in particular those shaped by trust. Trustworthy workers, and trustworthy infrastructures, can be relied on to provide either accurate water measurements or constant water flows and levels. Whilst this trust is often the result of personal relationships developed through time, it can also be the result of, or at least supported by, local economies that underpin the functioning of the System. Central radio operators, for example, receive payments from other operators in their jurisdiction. This money both produces them as trustworthy interlocutors, whilst allowing central operators to purchase the materials they need to carry out their work. In a context of deepening austerity, these contributions are crucial in allowing infrastructure management and operation.

In turn, the statistics and data produced by radio operators and other SACMEX experts work towards producing an ideal version of the grid. In Santiago's diagrams and charts, no leaks, no pressure losses, and no illegal water takes exist. Despite being aware of the 42% of the total water that is said to be lost daily, the way in which he carries out his calculations demand that the grid operates in a closed, abstract, manner. The assumptions he makes to

make the grid knowable depend on this closeness, as the numbers that he deploys require the stability that only the absence of leakage can provide. In setting this ideal version on paper, Santiago, alongside other workers who perform similar functions, are effectively making invisible the calculative, speculative, and affective practices that produce knowledge of the grid. This work of purification is the basis on which further reports of the grid are drafted, to be then circulated to senior SACMEX officials, the Mexico City government, and other interested parties that publish data on the grid. The mismatch between the material grid and its statistical and representational versions are productive of forms of management, control, and power in Mexico City.

Against assertions that practical knowledges are not assimilable for purposes of statecraft (Scott, 1998), here I have further shown how labour practices across SACMEX are fundamental in the production and reproduction of the state. In this chapter, I have analysed those that enable the making of nature into a manageable object. These include the calculative and speculative practices deployed in the field; solving pressing problems that threaten normal water flow; and the translation tasks that bureaucrats carry out when making water into an object of management beyond the confines of local SACMEX branches and offices. If one of the central tasks of the state is precisely the control and allocation of natural resources, the findings and arguments presented here suggest that, to fully understand how this function is carried out, attention needs to be paid to the everyday work that goes into managing and knowing nature. In performing this labour, workers are not only making a manageable, abstracted version of nature – in this case water – material. They are also making the state, and allowing government to perform its functions, even in contexts of increasing austerity and budgetary cuts. This indicates that labour, as a world-making practice and process, is integral in the conjoint production of state and nature through infrastructures. The problem of how and why certain political ecological configurations,

centred on urbanisation, and leading to the production of certain forms of state power come to be, can be better analysed if labour is fully considered.

8. CONCLUSIONS

This dissertation explored the role of human labour in managing, maintaining and repairing hydraulic infrastructures on the everyday, and how these current practices are rooted in and can be a standpoint to explore infrastructures' material history and its making. Its main argument has been that a range of human labour practices are necessary for infrastructures, and the relations and the configurations they enable, to become enduring and to adapt to ongoing change. The practices analysed here are those of archiving, operating, managing, maintaining and repairing. Whilst common in that they are instances of labour as a relational practice and process, each one of these offers a different standpoint to interrogate the durability and adaptability of relations between human work and infrastructure, and how these unfold in the making and maintenance of urban water, the city and the state. Through their particularities, they all show in different ways how infrastructural labour is crucial in maintaining and adapting not only material flows but also the promises that were made through them. In the Mexico City case, these are centred around the goal of transforming the city into a modern metropolis, where piped water and reliable supply are available to all. The fact that this promise remains unfulfilled (Castro, 2004; Schwarz, 2017) does not mean that its presence has disappeared from urban imaginaries and discourses, including those that inform workers practices and ways of seeing the city, the state and their labour.

Mexico City is more than the background where these practices take place. The city and its materialities, including those of soil, rust, water and ongoing austerity, are constantly shaping how labour unfolds and what it can do. Considering how matter matters (Bakker & Bridge, 2006), here I elaborate on a hybrid conception of labour that takes situatedness and geohistorical specificity as a site of theorisation. This certainly does not imply that the findings presented here might not be relevant elsewhere, but it calls for attention to local histories and forms when translating and thinking through the practices, processes and logics

that are conceptualised and explored here. This conception of labour, and how it is deployed to explain infrastructural durability amidst ongoing decay and austerity, is the main contributions this dissertation makes. By putting labour at the centre of my inquiry, I highlight how the endurance and stability of infrastructure, and of the relations and configurations it enables, require constant work. This echoes previous findings that highlight how service provision is a precarious achievement, always in the making (Baptista, 2019), but expands them by showing how these characteristics are also present in processes of statecraft, state making and modernisation.

Moreover, the approach taken here further theorises the particularities of labour, distinguishing between logics of maintenance and those of adaptation. I show how practices of archiving, operation and management seek to maintain the Lerma System in various ways, which range from the collective memory of the grid and the previous, present and potential future roles of labour, to the possibility of knowing water flows in highly uncertain conditions. Chapter 4 explores the question of archiving in detail. There, I make a two-fold argument: one, that everyday labour practices that challenge or exceed official histories and procedures are crucial in producing the Lerma System as an object that can be known, managed and researched. Despite their contentious relation to official ways of doing, these practices are crucial in bringing infrastructures under the gaze of the state and its experts, in particular in spaces and moments where funds are scarce and archives endure through the constant labour of specific workers. In those cases, archives also play a fundamental role in maintaining a memory of past labour that casts a critical light on its present conditions whilst offering the promise of better futures. By looking at the previous glory of the Lerma System, workers revalue their labour amidst ongoing austerity and breakdown.

The second argument looks at labour and expertise within the Lerma files, taking an ethnographic approach to archives (Stoler 2002; 2009). Following historical studies of water

and hydraulic infrastructures in Mexico in general, and in Mexico City in particular (Aboites Aguilar, 1998; 2009; 2012; Camacho Pichardo, 2007; Connolly, 1997; Perló Cohen 1989; 1999; Romero Lankao, 1999; Vitz, 2018), I show how the controversies, contentions, decisions and proposals contained in the Lerma Project files were crucial not only in producing infrastructures but in materialising state, nature and city making projects through them. As part of this argument, I show how the positions and narratives of experts working in the Lerma Project between 1941 and 1952 were informed by broader discussions on nature, history, expertise, and the role of the state in the production of urban modernity. This contributes to literature on water history in Mexico City, whilst highlight the relevance of these promises, projects and designs in understanding how infrastructure works today. By looking at archives as a site and archiving as a practice and process, I shed light on the present role that past narratives play in understanding the Lerma today.

Chapter 5 introduces the analytic of infrastructural aesthetics. Looking at four different sites throughout the Lerma System, I show how infrastructures enable certain modes of experiencing space, urban life and the promises made through infrastructure. At the same time, I highlight how this aesthetics are the outcome of numerous labour practices, productive, reproductive and adaptive. Finally, I shed light on how the materiality of infrastructure is crucial in understanding how these relations become sedimented in urban space, even if always part of numerous contentions that shape labour, city and state power. To explore these three dimensions of the aesthetic I deploy the concept of aesthetic register (Olcese & Savage, 2015). This is a heuristic device that brings together the experiential, productive and material dimensions of infrastructural aesthetics, allowing an empirical and conceptual exploration of how they come together in everyday life. By exploring how the interplay of three registers – visibility/invisibility; monumentality/mundanity; and formality/informality – works across sites I am able to analyse the making of state power,

livelihood, urban modernity and urban nature. These are contentious and fluid outcomes, always being shaped by diverse work practices and unruly materialities and enabling certain forms of living and experiencing the city.

On Chapter 6 I focus on questions of repair, which act at the moment of breakdown and its aftermath, and analyse them through the concept of patchwork. I show that this practice operates through a logic of adaptation, where incremental labour is fashioning normality not as a return to an official order (Barnes, 2017), but as an unfinished and ongoing process. I analyse this by delving into the ethnographic material gathered through working with four repair teams across SACMEX. I highlight how workers carry out fixes through practical knowledge, embodied expertise and ways of thinking and doing that are both anticipatory and improvisational. This means that workers are prepared in advance for the uncertainty of breakdown, namely by preparing numerous pieces and materials that can be repurposed to keep the grid functioning and water flowing, yet respond to ruptures in highly situated ways that are always being shaped by numerous material flows and blockages, as well as by human labour. These practices unfold in a context of deepening austerity, ongoing material decay, lack of resources and personnel, and profound socio-material change. In Mexico City, temporary and provisional fixes, made through the repurposing of diverse materials, are what makes the grid enduring and stable through a constant process of adaptation.

Finally, Chapter 7 looks at how a sprawling, complex system is made an object of bureaucratic knowledge, control and management. I show how the main problem engineers and workers across SACMEX face in this regard is that of the unknown. Despite the proliferation of statistics regarding water loss; the continuous drafting of reports that detail repair practices; and the existence of maps that represent the layout of the grid, hydraulic infrastructures and water escape both knowledge and calculation. The reasons for this are manifold. Austerity has led to a decrease in personnel and to the impossibility of surveying infrastructures.

Botched automatization projects mean that sites cannot be monitored remotely. Maps have not been actualised and do not contain information of many new neighbourhoods across the city. The informal production of space and infrastructure challenges official ways of representing and managing the grid, leading to increasing uncertainty. These processes, and indeed many other, lead to a growing problem of unknownability that workers must deal with constantly. To do so, they rely on memory, affect and practical knowledge. They create ways of doing that are able to make the unknown known and do so by eliminating the uncertainty that characterises their labour. Through practices of monitoring, mapping, reporting and counting they conjure a stable system that becomes an object of government knowledge and control.

A critical look at everyday labour reveals the contradictions, tensions and fragility of these forms of state power and water urbanisation. These, porous and fluid as they are, are also stable and enduring. This process requires of constant work. An analysis and conceptualisation of how this labour operates is the main contribution of this dissertation. In this, it follows work in infrastructure studies (Alda-Vidal, Kooy & Rusca, 2018; Anand, 2011; 2015; 2017; Baptista, 2019; Barnes, 2017; Björkman, 2015; 2018; Carse, 2014; Graham & Thrift, 2007; Silver, 2014; Simone, 2004a; 2004b; 2015). However, this work contributes distinctively to this scholarship by further theorising the role of labour in maintaining and adapting infrastructures through a situated analysis of diverse work practices in Mexico City. This situated theorising becomes a standpoint to interrogate how labour unfolds relationally with often unruly and unpredictable materialities, here those that make up soil, infrastructure, rust and water, and that are shaped by the particular geography and history of Mexico City. This concern with history and how infrastructure makes it sedimented and material is also a distinctive contribution of this dissertation, which I substantiate by looking at how histories of the Lerma System are a central part of present practices of labour and

expertise, as well as by looking at the promises that were made through the Lerma at the time of its construction. These promises, crucially, do not exist solely in the past, but are also at play when workers carry out diverse practices and are materialised in the very form of infrastructure.

In relation to literature on Mexico City and water, this work sits alongside a rich tradition of research. Water has been one of the central concerns of historians, sociologists, geographers, and political scientists working on and in Mexico City. The relation between the city and water has been discussed so thoroughly that it sometimes gains a mythical character, being framed as the source of numerous social and environmental plights since Mexico City's foundation until the present (Legorreta, 2006). This focus on grand historical processes has led to what some have called a "scandalizing" approach to water issues in the Mexican capital (Schwarz, 2017). The paradoxes of scarcity, excess (in the form of recurrent flooding), ground subsidence, and an ever-increasing thirst inform narratives focused on the extremes of a city on the brink of breakdown. Without denying the real threats and risks the city faces, which are also a main concern shared by workers and engineers, this dissertation focuses not on moments of potential and actual catastrophe, but in the labour that goes into sustaining the infrastructures that uphold a fragile normalcy in Mexico City. This focus on maintenance, repair, management, operation, and the everyday becoming of historical infrastructural processes and projects also contributes to studies of Mexico City, although the practices, logics and relations here explored might be significant elsewhere.

To conclude with, I want to reflect on what the conception of labour developed here might imply for theorisations of human labour in and through infrastructures; for those of hybridity and non-human agencies; and on how a research agenda around these topics might be developed. As mentioned before, the role of labour has been object of increasing attention across studies of infrastructure. These have shown that political ecological configurations,

the power of the state over space and infrastructure, and the very possibilities of making a living in unequal cities require constant work. In doing so, these analyses have contributed greatly to our understanding of how cities are made enduring, how infrastructures become stable, and how resources are kept flowing. However, the specificity of labour remains relatively undertheorized. This is visible in how, for example, preventative practices of maintenance are analysed jointly with those that follow breakdown, or in how the role of specific materialities, themselves the result of material histories and their unfolding in space, is theorised in relation to how shape and are shaped by everyday labour. Here I have shown how attention to how these geohistorically specific materialities and their everyday relations with labour allow for a more thorough conceptualisation of how work is carried out, learned collectively, and how it makes its bid for significance in a context of structural austerity and ongoing material decay.

Attention to the everyday practices of human labour through infrastructures, and to the diverse logics that shape it, can also be a productive standpoint to interrogate questions of hybridity and non-human agencies. By distinguishing between the work of maintenance and that of repair, for example, I have been able to highlight how incrementality, convertibility and improvisation enable workers to fashion normality, in relation to water flows, as an ongoing and unfinished process. This suggests that historical processes made material through infrastructures, like urban modernity or nature urbanisation, are too unfinished and ongoing, always in the making (Baptista, 2019). However, material history is also shaping work constantly. In the case of Mexico City, processes of infrastructure ruination, such as rusting, and those of soil subsidence, aquifer depletion and the mounting effects of austerity bound and shape everyday labour. Workers are able to adapt the grid to these continuous changes and their often-unpredictable materialisations, yet they cannot do so freely. Materiality matters and does so in ways that are always already human agency as a relational

process that is also non-human. This distributive logic, however, does not necessarily imply a symmetry between the human and the non-human (Latour, 2005). Here I have highlighted how workers' practical knowledge and embodied expertise is distinctive and purposeful, and even if always already hybrid, it is also particular and specific. Empirical attention to how the human and the non-human interact in situated analyses can advance our knowledge of how agency comes to be and how it participates in the making, maintain and adapting of socio-material forms, processes and practices.

DIRECTIONS FOR FUTURE RESEARCH ON LABOUR AND INFRASTRUCTURE

The findings and arguments presented in this dissertation are shaped by its research object: the Lerma System. The role it has played in producing, maintaining, and adapting state power through water urbanisation is related to other socio-material processes that unfolded both around and through its infrastructures. The Manuel Ávila Camacho (1940-1946) and, particularly, the Miguel Alemán presidency (1946-1952) marked a transition from the populist, agrarian, and (at least discursively) pro-socialist stance of Lázaro Cárdenas (1934-1940) towards a decidedly capitalist, urban-centred programme of modernisation (Medin, 1990; López-Portillo Tostado, 1995). These trends are partially produced through the Lerma, as it shifted water from rural and agrarian functions towards urban and industrial ones. An ethnographic exploration of the Lerma infrastructures, the relations they bring together and further, and the work that goes into maintaining them allows to describe and explain how these political, economic, technological, and ecological projects have been built and made enduring. It also shows how these projects, as they unfold materially and historically, are riddled with contradictions, gaps and breakdowns, and how the task of keeping them together and making them adapt to changing conditions through everyday labour is productive of state power and urban political ecological configurations.

It is possible to explore different infrastructures with a similar intent. In the case of Mexico City, other water supply systems have been built after the Lerma. Of particular importance is the Cutzamala System, built between 1972 and 1993, and with planned expansions that are still to be built, not without numerous resistances and contentions (Gómez-Fuentes, 2009; González Reynoso, 2016). The Cutzamala seems to be productive of different infrastructural configurations, which respond to changes in international and national political economic trends and practices. If the Lerma was built through state-emitted public debt and taxes, the Cutzamala was financed through World Bank, Interamerican Development Bank, and state-issued debt mechanisms. Whilst the former was, and still is, administered by the Mexico City government, the latter is and was managed by the Federal one. The Lerma linked, and subordinated, the homonymous area to Mexico City; the Cutzamala expanded this political ecological logic, tapping into ever more distant waters to supply the Mexican Capital, creating what has recently been termed the Mexico City 'hydropolitan' region (González Reynoso, 2016). Conversely, the modernising projects that were being made material through these water supply systems differ greatly. Whilst the Lerma puts forward the ideal of a fully planned entry into modernity, the Cutzamala was framed as an urgent necessity against a city already growing beyond control. These questions could be explored as an extension of this project, as there are both empirical and conceptual grounds to do so.

At the same time, attention to emerging patterns centred on digital technologies, smart city projects and practices, and their integration with other networked infrastructures and infrastructural configurations can be useful to understanding how governance and power are being made and challenged in contemporary urban space, and how labour practices are being transformed as a result. In SACMEX, concerns about decreasing water availability, increasing demand, and the survival of Mexico City highlight how uncertainty has become a

widespread form to understand the future. How to ensure the city thrives, or at least survives, is a contentious point amongst workers, engineers, bureaucrats, and elected politicians. Hopes are partially placed on modernisation efforts, where automatized measuring devices and other smart interventions are framed as ways of making the grid more efficient. Other potential solution being rolled out in Mexico City by its new government is the installation of household rainwater collectors, designed as a way to reduce dependency on piped water. However, many SACMEX employees are wary of both solutions as they believe the only real option for Mexico City is to again increase its water supply by tapping evermore distant sources. In this view, the urban political ecology of water supply in the Mexican capital resembles a vortex, shifting its unsustainability to increasing scales both temporal and geographical.

Certainly, these insights can be expanded beyond Mexico City. It would be indeed relevant to explore how other cities in Mexico have been shaped by infrastructures, and how they are being maintained and adapted today. In a context of historical centralisation, this exploration can be relevant in depicting how ordinary cities (Robinson, 2006) are made and endure. Similarly, these insights could be a useful starting point to researching cities in other Latin American countries, where state power has been central to the tasks of urbanisation and modernisation in particular ways. Both agendas are already being developed by numerous scholars, and such a research programme is already underway across the social sciences (Healey, 2011; Hetherington & Campbell, 2014; Harvey & Knox, 2015; Hines, 2018; Millington, 2018). This dissertation, and its conclusions, certainly aim to enter in a productive, critical conversation with these contributions. At the same time, it is possible to explore how futures are being designed and built in this wider geography, in particular as large-scale infrastructural projects promise to reshape the continent proliferate. In south

Mexico, for example, a new Mayan Train⁵³ is being rolled out, shifting the locus of the infrastructural making of state power, urbanisation and capitalist development from the centre to a globally connected periphery. How labour might make these projects material, and how a study of its everyday performances might surface diverse contradictions, tensions and adaptive practices is a task that could offer important critical insights into the many relations and processes that these projects enable.

Finally, the methodological and analytical approach developed through the Lerma in this dissertation could also be a standpoint to theorise how urban processes unfold beyond the North Atlantic. Here, I have highlighted how the process of splintering is not necessarily part of a neoliberal moment (Graham & Marvin, 2001), but a constitutive infrastructural condition of the urban process, in line with other analysis of post-colonial metropolises (Gandy, 2014). Similarly, I have shown how commodification is a contentious, incomplete process, in which the state claims a centrality it is unable to uphold on the everyday. The state is indeed central to the production and reproduction of the urban process, and to the political ecological relations that maintain and further it beyond the process of water urbanisation. This role challenges view of urbanisation in which capital plays a much more central role. I suggest that this is not a deviation from a historical norm, but rather shows the plural character of urbanisation. These arguments resonate with the claims made by authors putting forward accounts of Southern urban theory (Schindler, 2017), and practice (Bhan, 2019), where the role of capital is not the solely determinant of the unfolding of the urban process, and where ingenuity, creativity, self-construction, self-management, and practical knowledge play a much more central role. Further research on the role of labour in making, maintaining and adapting infrastructures and infrastructural configurations could advance our understanding

⁵³ <http://www.trenmaya.gob.mx/>

of hybridity, socio-materiality and power across urban spaces both in the Global South and North.

REFERENCES

- Aboites Aguilar, L. (1995). El Archivo Histórico del Agua: una opción para la historia económica de la primera mitad del siglo XX. *América Latina en la Historia Económica*, 2(3), 107-109.
- Aboites Aguilar, L. (1998). *El agua de la nación: una historia política de México (1888-1946)*. Mexico City: Centro de Investigaciones y Estudios Superiores en Antropología Social.
- Aboites Aguilar, L. (2009). *La Decadencia del Agua de la Nación: Estudio Sobre Desigualdad Social y Cambio Político En México*. Mexico City: El Colegio de México.
- Aboites Aguilar, L. (2012). The Illusion of National Power: Water Infrastructure in Mexican Cities, 1930-1990. In C. R. Boyer, *A Land Between Waters: Environmental Histories of Modern Mexico* (pp. 218-244). Tucson, AZ: The University of Arizona Press.
- Aguilar, A. G., & López, F. M. (2009). Water Insecurity among the Urban Poor in the Peri-urban Zone of Xochimilco, Mexico City. *Journal of Latin American Geography*, 8(2), 97-123.
- Aguilar, J. A. (2007, March). El excusado y la barbarie. *Consumidor*, pp. 70-73.
- AHA. (1994a, May - August). Presentación. *Boletín del Archivo Histórico del Agua*, pp. 1-3.
- AHA. (1994b). Los acervos del AHA. *Boletín del Archivo Histórico del Agua*, 1(2), 2-3.
- AHA. (1996). Presentación. *Boletín del Archivo Histórico del Agua*, 3(7), 1-2.
- AHA. (1997). Presentación. *Boletín del Archivo Histórico del Agua*, 4(10), 1.
- Albores Zárate, B. A. (1995). *Tules y sirenas: el impacto ecológico y cultural de la industrialización del Alto Lerma*. Toluca: El Colegio Mexiquense - Gobierno del Estado de México.
- Alda-Vidal, C., Kooy, M., & Rusca, M. (2018). Mapping operation and maintenance: an everyday urbanism analysis of inequalities within piped water supply in Lilongwe, Malawi. *Urban Geography*, 39(1), 104-121.
- Alfaro Siqueiros, D. (1948). Hacia una nueva plástica integral. *Espacios*, 1(1).
- Allen, A., Hofmann, P., Mukherjee, J., & Walnycki, A. (2017). Water trajectories through non-networked infrastructure: insights from peri-urban Dar es Salaam, Cochabamba and Kolkata. *Urban Research & Practice*, 22-42.
- Amin, A., & Thrift, N. (2017). *Seeing Like a City*. Cambridge: Polity Press.
- Anand, N. (2011). PRESSURE: The PoliTechnics of Water Supply in Mumbai. *Cultural Anthropology*, 542-564.
- Anand, N. (2015). Leaky States: Water Audits, Ignorance, and the Politics of Infrastructure. *Public Culture*, 27(2), 305-330.
- Anand, N. (2017). *Hydraulic City: Water & the Infrastructures of Citizenship in Mumbai*. Durham, NC: Duke University Press.
- Anand, N., Gupta, A., & Appel, H. (2018). *The Promise of Infrastructure* (1st ed.). London: Duke University Press.
- Angelo, H., & Hentschel, C. (2015). Interactions with infrastructure as windows into social worlds: A method for critical urban studies: Introduction. *City*, 306-312.

- Appel, H. (2018). Infrastructural Time. In N. Anand, A. Gupta, & H. Appel (Eds.), *The Promise of Infrastructure* (pp. 41-61). London: Duke University Press.
- Aquino, E. (2017, October 1). *Sismo dejó sin agua y en crisis al sur-orienté de la Ciudad de México*. Retrieved from Animal Político: <https://www.animalpolitico.com/2017/10/sismo-agua-crisis-sur-orienté-ciudad/>
- Arboleda, M. (2016). Spaces of Extraction, Metropolitan Explosions: Planetary Urbanization and the Commodity Boom in Latin America. *International Journal of Urban and Regional Research*, 40(1), 96-112.
- Arboleda, M. (2017). Revitalizing science and technology studies: A Marxian critique of more-than-human geographies. *Environment and Planning D: Society and Space*, 360-378.
- Arenas-Valdés, M. (1948). Breves apreciaciones sobre la hidrología del Valle de México y el aprovechamiento de sus recursos hidráulicos en la resolución de sus principales problemas. *Ingeniería Hidráulica en México*, II(1), 23-28.
- Bakker, K., & Bridge, G. (2006). Material worlds? Resource geographies and the 'matter of nature'. *Progress in Human Geography*, 30(1), 5-27.
- Banister, J. M., & Widdifield, S. G. (2014). The debut of 'modern water' in early 20th century Mexico City: the Xochimilco potable waterworks. *Journal of Historical Geography*, 36-52.
- Banister, J. M., & Widdifield, S. G. (2016). The History and Visual Culture of Mexico City's Xochimilco Potable Water System during the Porfiriato. *Latin American History: Oxford Research Encyclopedias*, 1-37.
- Baptista, I. (2019). Electricity services always in the making: Informality and the work of infrastructure maintenance and repair in an African city. *Urban Studies*, 56(3), 510-525.
- Barnes, J. (2014). *Cultivating the Nile: The Everyday Politics of Water in Egypt*. Durham, NC: Duke University Press.
- Barnes, J. (2017). States of maintenance: Power, politics, and Egypt's irrigation infrastructure. *Environment and Planning D: Society and Space*, 146-164.
- Bear, L. (2014). For labour: Ajeet's accident and the ethics of technological fixes in time. *Journal of the Royal Anthropological Institute*, 20(S1), 71-88.
- Bennett, J. (2010). *Vibrant Matter: a political ecology of things*. Durham, NC: Duke University Press.
- Berlant, L. (2016). The commons: Infrastructures for troubling times. *Environment and Planning D: Society and Space*, 393-419.
- Bhan, G. (2019). Notes on a Southern urban practice. *Environment and Urbanization*, 1-16.
- Björkman, L. (2015). *Pipe Politics, Contested Waters: Embedded Infrastructures of Millennial Mumbai*. Durham, NC: Duke University Press.
- Björkman, L. (2018). The Engineer and The Plumber: Mediating Mumbai's Conflicting Infrastructural Imaginaries. *International Journal of Urban and Regional Research*, 42(2), 276-294.
- Björkman, L., & Harris, A. (2018). Engineering Cities: Mediating Materialities, Infrastructural Imaginaries and Shifting Regimes of Urban Expertise. *International Journal of Urban and Regional Research*, 42(2), 244-262.

- Boehm de Lameiras, B., & Sandoval Manzo, M. (1999). La sed saciada de la ciudad de México: la nueva cuenca Lerma-Chapala-Santiago. Un ensayo metodológico de lectura cartográfica. *Relaciones*, 17-61.
- Brenner, N., Madden, D. J., & Wachsmuth, D. (2011). Assemblage urbanism and the challenges of critical urban theory. *City: analysis of urban trends, culture, theory, policy, action*, 225-240.
- Bridge, G. (2010). Resource geographies I: Making carbon economies, old and new. *Progress in Human Geography*, 35(6), 820-834.
- Bridge, G. (2014). Resource geographies II: The resource-state nexus. *Progress in Human Geography*, 38(1), 118-130.
- Cabral-Cano, E., Dixon, T. H., Miralles-Wilhelm, F., Díaz-Molina, O., Sánchez-Zamora, O., & Carande, R. E. (2008). Space geodetic imaging of rapid ground subsidence in Mexico City. *GSA Bulletin*, 120(11-12), 1556–1566.
- Caldeira, T. (2000). *City of walls : crime, segregation, and citizenship in São Paulo* (1st ed.). Berkeley: University of California Press.
- Calderón Cockburn, J. (1987). Luchas por la tierra, contradicciones sociales y sistema político. El caso de las zonas ejidales y comunales en la ciudad de México (1980-1984). *Estudios Demográficos y Urbanos*, 2(2), 301-324.
- Camacho Pichardo, G. (1998). Proyectos hidráulicos en las lagunas del Alto Lerma. In B. E. Suárez Cortez (Ed.), *Historia de los usos del agua en México: oligarquías, empresas y ayuntamientos (1840-1940)* (pp. 229-279). Mexico City: CNA - CIESAS - IMTA.
- Camacho Pichardo, G. (2007). *Agua y liberalismo. El proyecto estatal de desecación de las lagunas del Alto Lerma, 1850-1875*. Mexico City: Centro de Investigaciones y Estudios Superiores en Antropología Social.
- Campos Bravo, A. (1945, March 8). Agua Bastante Para la Ciudad. *El Nacional*.
- Candiani, V. (2014). *Dreaming of Dry Land: Environmental Transformation in Colonial Mexico City*. Stanford, CA: Stanford University Press.
- Capilla Vilchis, R. (2018, December 5). *La crisis del agua en México*. Retrieved from Agua.org.mx: <https://agua.org.mx/la-crisis-del-agua-en-mexico-conacyt/>
- Carr, E. S. (2010). Enactments of Expertise. *Annual Review of Anthropology*, 39, 17-32.
- Carse, A. (2012). Nature as infrastructure: Making and managing the Panama Canal watershed. *Social Studies of Science*, 539-563.
- Carse, A. (2014). *Beyond the Big Ditch: Politics, Ecology, and Infrastructure at the Panama Canal*. Cambridge: The MIT Press.
- Carse, A. (2017a). An Infrastructural Event: Making Sense of Panama's Drought. *Water Alternatives*, 888-909.
- Carse, A. (2017b). Keyword: Infrastructure. How a Humble French Engineering Term Shaped the Modern World. In P. Harvey, C. B. Jensen, A. Morita, P. Harvey, C. Bruun Jensen, & A. Morita (Eds.), *Infrastructure and Social Complexity: A Routledge Companion* (pp. 27-39). New York: Routledge.
- Carter, W. (2014). Painting the Revolution. *Third Text*, 28(3), 282-291.

- Castán-Broto, V., & Harriet, B. (2013). Maintaining Climate Change Experiments: Urban Political Ecology and the Everyday Reconfiguration of Urban Infrastructure. *International Journal of Urban and Regional Research*, 37(6), 1934-48.
- Castañeda Abanto, D. (2004). Palabras pronunciadas por la doctora Teresa Rojas Rabiela durante la inauguración del Coloquio "Agua. Nuevas perspectivas de investigación". *Boletín del Archivo Histórico del Agua*, 9(26), 5-9.
- Castañeda, R., & Camacho, G. (1995). Presentación. *Boletín del Archivo Histórico del Agua*, 1(3), 1.
- Castree, N. (2002). False Antitheses? Marxism, Nature and Actor-Networks. *Antipode*, 111-146.
- Castro, J. E. (2004). Urban water and the politics of citizenship: the case of the Mexico City Metropolitan Area during the 1980s and 1990s. *Environment and Planning A*, 327-346.
- Chu, J. Y. (2014). When infrastructures attack: The workings of disrepair in China. *American Ethnologist*, 351-367.
- Cirelli, C. (1997). *La transferencia de agua: el impacto en las comunidades origen del recurso. El caso de San Felipe y Santiago, Estado de México*. Mexico City: Universidad Iberoamericana.
- Collier, S. J. (2011). *Post-Soviet Social : neoliberalism, social modernity, biopolitics*. Princeton, NJ: Princeton University Press.
- CONAGUA. (2018). *Estadísticas del Agua en México*. Mexico City: CONAGUA.
- Connolly, P. (1997). *El contratista de Don Porfirio. Obras públicas, deuda y desarrollo desigual*. Mexico City: Fondo de Cultura Económica.
- Correa, G. (1982, February 17). Los detalles de la fortaleza. *Proceso*.
- Craib, R. B. (2004). *Cartographic Mexico: A History of State Fixations and Fugitive Landscapes*. Durham, NC: Duke University Press.
- Cullell, J. M. (2019, December 5). *La plomería infinita de la ciudad con 13.000 kilómetros de tubería*. Retrieved from El País: https://elpais.com/sociedad/2019/12/05/actualidad/1575507656_866002.html
- DDF. (1951). *Obras para Provisión de Agua Potable para la Ciudad de México. Sistema Lerma*. Mexico City: DDF.
- DDF; Secretaría de la Presidencia. (1976). *México a través de los informes presidenciales*. Mexico City: DDF - Secretaría de la Presidencia.
- de Alba, F. (2017). Challenging state modernity: Governmental adaptation and informal water politics in Mexico City. *Current Sociology*, 65(2), 182-194.
- de Alba, F. & Amaya, L. (2014). *Estado y ciudadanías del agua. Cómo significar las nuevas relaciones*. Mexico City, UAM-C
- de la Garza Toledo, E., Melgoza, J., de la Garza, L., Laviada, E., Trujillo, M., Sánchez, V., . . . Rojo, G. (1994). *Historia de la Industria Eléctrica en México* (1st ed., Vol. I). Ciudad de México: UAM-Iztapalapa.
- Deleuze, G., & Guattari, F. (2004). *A thousand plateaus: capitalism and schizophrenia*. London: Continuum.

- Delgadillo Polanco, V. M. (2012). El derecho a la ciudad en la Ciudad de México. ¿Una retórica progresista para una gestión neoliberal? *Andamios*, 9(18), 117-139.
- Denis, J., & Pontille, D. (2014). Maintenance work and the performativity of urban inscriptions: the case of Paris subway signs. *Environment and Planning D: Society and Space*, 32, 404-416.
- Denis, J., & Pontille, D. (2015). Material Ordering and the Care of Things. *Science, Technology & Human Values*, 338-367.
- Departamento del Distrito Federal. (1949). *Las Obras de Lerma: Trabajos presentados al Primer Congreso Internacional de Ingeniería Civil, celebrado en la Ciudad de México en abril-mayo de 1949*. Mexico City: Departamento del Distrito Federal.
- Departamento del Distrito Federal. (1951). *Obras para Provisión de Agua Potable para la Ciudad de México. Sistema Lerma*. Mexico City: DDF.
- Diario Oficial de la Federación. (1966, December 16). Mexico City, Mexico: DOF. Retrieved from http://dof.gob.mx/nota_to_imagen_fs.php?codnota=4710708&fecha=16/12/1966&cod_diario=203001
- Domínguez Rubio, F. (2016). On the discrepancy between objects and things: An ecological approach. *Journal of Material Culture*, 21(1), 59-86.
- Doremus, A. (2001). Indigenism, Mestizaje, and National Identity in Mexico during the 1940s and the 1950s. *Mexican Studies / Estudios Mexicanos*, 17(2), 375-402.
- Duana, N., Ríos, J., & García, S. (2004). El Archivo Histórico del Agua a diez años de su creación: memoria, experiencia e innovación. *Boletín del Archivo Histórico del Agua*, 9(26), 10-28.
- Duhau, E., & Girola, L. (1990). La ciudad y la modernidad inconclusa. *Acta Sociológica*, 5(12), 1-18.
- Durán, N., & Becerril-Colín, A. (1948). Las aguas del Valle de México y su aprovechamiento para dotar de agua a la ciudad. *Revista Mexicana de Ingeniería y Arquitectura*, XXVI(4-5-6), 105-114.
- Esteller, M., & Díaz-Delgado, C. (2002). Environmental effects of aquifer overexploitation: a case study in the highlands of Mexico. *Environmental Management*, 29(2), 266-278.
- Fredericks, R. (2018). *Garbage Citizenship: Vital Infrastructures of Labor in Dakar, Senegal* (1st ed.). London: Duke University press.
- Fuentes, C. (2008). *La región más transparente*. Mexico City: Real Academia Española - Asociación de Academias de la Lengua Española.
- Gallo, R. (2005). *Mexican Modernity: The Avant-Garde and the Technological Revolution* (1st Edition ed.). Cambridge, MA: The MIT Press.
- Gandy, M. (2002). *Concrete and clay: reworking nature in New York City*. London: The MIT Press.
- Gandy, M. (2005). Cyborg Urbanization: Complexity and Monstrosity in the Contemporary City. *International Journal of Urban & Regional Research*, 29(1), 26-49.
- Gandy, M. (2008). Landscapes of disaster: water, modernity, and urban fragmentation in Mumbai. *Environment and Planning A*, 40, 180-130.

- Gandy, M. (2014). *The fabric of space: water, modernity, and the urban imagination*. Cambridge, MA: The MIT Press.
- Gandy, M. (2018). Cities in deep time. *City: analysis of urban trends, culture, theory, policy, action*, 22(1), 96-105.
- García Chávez, R. (2007). El Altepétl como formación sociopolítica de la cuenca de México. Su origen y desarrollo durante el posclásico. *Arqueoweb: Revista sobre Arqueología en Internet*.
- García-Quintero, A. (1951). Hidrología superficial del Valle de México. *Ingeniería Hidráulica en México*, V(1), 5-9.
- Gareau, B. J. (2005). We Have Never Been Human: Agential Nature, ANT, and Marxist Political Ecology. *Capitalism, Nature, Socialism*, 127-140.
- Geertz, C. (1973). *The Interpretation of Cultures: Selected Essays*. New York: Basic Books.
- Ghertner, D. A. (2015). *Rule by Aesthetics: World-Class City Making in Delhi* (1st ed.). Oxford: Oxford University Press.
- Ghertner, D. A. (2017). When is the State? Topology, Temporality and the Navigation of Everyday State Space in Delhi. *Annals of the American Association of Geographers*, 107(3), 731-750.
- Gómez Valdez, M. I. (2015). *Abastecimiento de agua potable por pipas en el Valle de Texcoco* (PhD Dissertation ed.). Texcoco, Mexico: Colegio de Postgraduados.
- Gómez-Fuentes, A. (2009). An Army of Women, an Army for Water. The Mazahua Indigenous Women of Mexico. *Agricultura, Sociedad y Desarrollo*, 207-221.
- González Reynoso, A. E. (2016). *La región hidropolitana de la Ciudad de México: conflicto gubernamental y social por los trasvases Lerma y Cutzamala*. Ciudad de México: Instituto Mora - CONACyT.
- Graham, S., & Marvin, S. (2001). *Splintering Urbanism: networked infrastructures, technological mobilities and the urban condition* (1st ed.). London: Routledge.
- Graham, S., & Thrift, N. (2007). Out of Order: Understanding Repair and Maintenance. *Theory, Culture & Society*, 24(3), 1-25.
- Gupta, A. (2018). The Future in Ruins: Thoughts on the Temporality of Infrastructure. In N. Anand, A. Gupta, & H. Appel (Eds.), *The Promise of Infrastructure* (pp. 62-79). London: Duke University Press.
- Haraway, D. J. (1991). *Simians, cyborgs, and women the reinvention of nature*. New York: Routledge.
- Harney, S. (2002). *State Work: Public Administration and Mass Intellectuality* (1st ed.). Durham, NC: Duke University Press.
- Harvey, D. (1985). *The Urbanisation of Capital*. Oxford: Blackwell.
- Harvey, D. (1990). *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change*. Cambridge, MA: Blackwell Publishing.
- Harvey, D. (1993). The Nature of Environment: Dialectics of Social and Environmental Change. *Socialist Register*, 1-50.
- Harvey, P. (2018). Infrastructures in and out of Time: The Promise of Roads in Contemporary Peru. In N. Anand, A. Gupta, & H. Appel (Eds.), *The Promise of Infrastructure* (pp. 80-101). London: Duke University Press.

- Harvey, P., & Knox, H. (2015). *Roads: an Anthropology of Infrastructure and Expertise*. NY: Cornell University Press.
- Healey, M. A. (2011). *The ruins of the new Argentina : Peronism and the remaking of San Juan after the 1944 earthquake*. Durham, NC: Duke University Press.
- Hetherington, K., & Campbell, J. M. (2014). Nature, Infrastructure, and the State: Rethinking Development in Latin America. *The Journal of Latin American and Caribbean Anthropology*, 19(2), 191-194.
- Heynen, N., Kaika, M., & Swyngedouw, E. (2006). *Urban Political Ecology and the Politics of Urban Metabolism*. London: Routledge.
- Hines, S. (2018). The Power and Ethics of Vernacular Modernism: The Misicuni Dam Project in Cochabamba, Bolivia, 1944-2017. *Hispanic American Historical Review*, 98(2), 223-256.
- Hinojosa, Ó. (1982, July 3). Bosques de las Lomas invade predios populares. *Proceso*.
- Hull, M. S. (2012). *Government of Paper: the materiality of bureaucracy in urban Pakistan* (1st ed.). Berkeley, CA: University of California Press.
- INEGI. (2009). *Estadísticas Históricas de México*. Mexico City: INEGI.
- INEGI. (2017). *Encuesta Origen-Destino en hogares de la Zona Metropolitana del Valle de México*. Mexico City: INEGI.
- Jackson, S. J. (2014). Rethinking repair. In T. Gillespie, P. J. Boczowski, & K. A. Foot, *Media Technologies: Essays on Communication, Materiality, and Society* (pp. 221–240). Cambridge, MA: The MIT Press.
- Jaguaribe, B. (1999). Modernist Ruins: National Narratives and Architectural Forms. *Public Culture*, 294-312.
- Jiménez Lopez, C. (1953). Organización y financiamiento de los sistemas de agua potable en la República Mexicana. *Revista Mexicana de Ingeniería y Arquitectura*, XXXI(4-5-6), 73-32.
- Jones, G. A., & Ward, P. M. (1998). Privatizing the commons: reforming the ejido and urban development in Mexico. *International Journal of Urban and Regional Research*, 22(1), 76-93.
- Kaika, M. (2004). Interrogating the Geographies of the Familiar: Domesticating Nature and Constructing the Autonomy of the Modern Home. *International Journal of Urban and Regional Research*, 28(2), 265-286.
- Kaika, M. (2005). *City of Flows: Modernity, Nature, and the City*. Oxford: Routledge.
- Kaika, M., & Swyngedouw, E. (2000). Fetishizing the modern city: the phantasmagoria of urban technological networks. *International Journal of Urban and Regional Research*, 120-138.
- Kimmelman, M. (2017). *Mexico City, Parched and Sinking, Faces a Water Crisis*. Retrieved December 14, 2018, from <https://www.nytimes.com/interactive/2017/02/17/world/americas/mexico-city-sinking.html>
- Kirsch, S., & Mitchell, D. (2004). The Nature of Things: Dead Labor, Nonhuman Actors, and the Persistence of Marxism. *Antipode*, 687-705.

- Lancione, M., & McFarlane, C. (2016). Infrastructural becoming. Sanitation, cosmopolitics, and the (un)making of urban life at the margins. In I. Farías, & A. Blok, *Urban Cosmopolitics. Agencements, assemblies, atmospheres* (pp. 45-62). London: Routledge.
- Larkin, B. (2013). The Politics and Poetics of Infrastructure. *Annual Review of Anthropology*, 327-343.
- Larkin, B. (2018). Promising Forms: The Political Aesthetics of Infrastructure. In N. Anand, A. Gupta, & H. Appel (Eds.), *The Promise of Infrastructure* (pp. 175-202). London: Duke University Press.
- Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard University Press.
- Latour, B. (1993). *We have never been modern*.
- Latour, B. (1993). *We have never been modern*. Cambridge, MA: Harvard University Press.
- Latour, B. (2005). *Reassembling the social : an introduction to actor-network-theory*. Oxford: Oxford University Press.
- Lawhon, M., Ernstson, H., & Silver, J. (2014). Provincializing Urban Political Ecology: Towards a Situated UPE Through African Urbanism . *Antipode*, 497-516.
- Lawhon, M., Nilsson, D., Silver, J., Ernstson, H., & Lwasa, S. (2018). Thinking through heterogeneous infrastructure configurations. *Urban Studies*, 55(4), 720-732.
- Legorreta, J. (2006). *El agua y la Ciudad de México: de Tenochtitlán a la megalópolis del siglo XXI*. Mexico City: Universidad Autónoma Metropolitana - Azcapotzalco.
- Lévi-Strauss, C. (1966). *The Savage Mind*. London: Weidenfeld and Nicolson.
- Loftus, A. (2007). Working the Socio-Natural Relations of the Urban Waterscape in South Africa. *International Journal of Urban and Regional Research*, 41-59.
- Loftus, A. (2012). *Everyday environmentalism: creating an urban political ecology*. Minneapolis, MI: University of Minnesota Press.
- López, J. (2012). "In the art of my profession": Adrian boot and Dutch water management in Colonial Mexico City. *Journal of Latin American Geography*, 11, 35-60.
- López-Portillo Tostado, F. (1995). *Estado e ideología empresarial en el gobierno alemanista*. Mexico City: UNAM.
- Maderey-Rascón, L., & Jiménez-Román, A. (2001). Hydrological cycle disturbances at the lower portion of the Lerma River upper basin derived from water transfer to Mexico City. *Investigaciones Geográficas*, 45, 24-38.
- Mangset, M., & Asdal, K. (2018). Bureaucratic power in note-writing: authoritative expertise within the state. *The British Journal of Sociology*, 1-20.
- Martínez Omaña, M. C. (2002). *La Gestión Privada de un Bien Público: El caso del agua en el Distrito Federal, 1988-1995*. Mexico City: Instituto Mora / Plaza y Valdés Editores.
- Marx, K. (1993). *Grundrisse: Foundations of the Critique of Political Economy*. London: Penguin Books.
- Marx, K. (2004). *Capital: A Critique of Political Economy* (Vol. I). London: Penguin Books.
- Marx, K., & Engels, F. (1959). *Collected Works* (Vol. 3). London: Lawrence & Wishart - Progress Publishers.

- McFarlane, C. (2011). Assemblage and critical urbanism. *City: analysis of urban trends, culture, theory, policy, action*, 15(2), 204-224.
- Medin, T. (1990). *El sexenio alemanista: ideología y praxis política de Miguel Alemán*. Mexico City: Ediciones Era.
- Medina, L. (1978). *Historia de la Revolución Mexicana. Periodo 1940-1952. Del cardenismo al avilacamachismo*. Mexico City: El Colegio de México.
- Meehan, K. M. (2014). Tool-power: Water infrastructure as wellsprings of state power. *Geoforum*, 215-224.
- Millington, N. (2018). Producing water scarcity in São Paulo, Brazil: The 2014-2015 water crisis and the binding politics of infrastructure. *Political Geography*, 26-34.
- Mitchell, T. (2002). *Rule of experts: Egypt, techno-politics, modernity*. Berkeley: University of California Press.
- Moatasim, F. (2018). Entitled urbanism: Elite informality and the reimagining of a planned modern city. *Urban Studies*, 00(0), 1-17.
- Molina, E. (1939). El Sistema de Abastecimiento de Agua Potable en el Distrito Federal. *La Revista Mexicana de Ingeniería y Arquitectura*, 293-307.
- Moore, J. W. (2015). *Capitalism in the Web of Life: Ecology and the Accumulation of Capital*. New York: Verso Books.
- Morales, A. (2016, May 05). SACM reclama recorte a presupuesto para 2017. *El Universal*.
- Morehart, C. T. (2016). Chinampa Agriculture, Surplus Production, and Political Change at Xaltocan, Mexico. *Ancient Mesoamerica*, 183-196.
- Moreno Carrasco, M. (2008). La producción espacial de lo global: lo público y lo privado en Santa Fe, Ciudad de México. *Alteridades*, 18(36), 75-86.
- Noelle, L. (2001). Integración plástica y funcionalismo. El edificio del Cárcamo del Sistema Hidráulico Lerma y Ricardo Rivas. *Anales del Instituto de Investigaciones Estéticas*, 189-202.
- Noticieros Televisa. (2019, January 18). *Sacmex tendrá presupuesto de 5, 977 mdp en 2019: Sheinbaum*. Retrieved from Noticieros Televisa: <https://noticieros.televisa.com/ultimas-noticias/sacmex-tendra-presupuesto-de-5-977-mdp-en-2019-sheinbaum/>
- Novelo, J., & Tapia, L. (2012). The Growth of Water Demand in Mexico City and the Over-exploitation of its Aquifers. In Ú. Oswald Spring, *Water Resources in Mexico* (pp. 395-406). Berlin: Springer.
- Olcese, C., & Savage, M. (2015). Notes towards a 'social aesthetic': Guest editors' introduction to the special section. *British Journal of Sociology*, 66(4), 720-737.
- Orive Alba, A. (1947). Informe de Labores de la Secretaría de Recursos Hidráulicos. *Ingeniería Hidráulica en México*.
- Palerm, Á. (2007). *Agua y Agricultura: Ángel Palerm, la discusión con Karl Wittfogel sobre el Modo Asiático de Producción y la consturcción de un modelo para el estudio de Mesoamérica*. Mexico City: Universidad Iberoamericana.
- Parenti, C. (2014). The Environment Making State: Territory, Nature, and Value. *Antipode*, 829-848.

- Parenti, C. (2016). Environment-Making in the Capitalocene: Political Ecology of the State. In J. W. Moore (Ed.), *Anthropocene or Capitalocene? Nature, History and the Crisis of Capitalism* (pp. 166-184). Oakland, CA: PM Press.
- Pérez-Castro, L. (1954). Funcionamiento de la Comisión Hidrológica del Valle de México. *Revista Mexicana de Ingeniería y Arquitectura*, XXXIII(5), 21-36.
- Perló Cohen, M. (1989). *Historia de las obras, planes y problemas hídricos en el Distrito Federal: 1880-1987* (1st ed.). Mexico City: UNAM.
- Perló Cohen, M. (1999). *El paradigma porfiriano: historia del desagüe del Valle de México* (1st ed.). Mexico City: UNAM-IIS.
- Perló Cohen, M. (1999). *El paradigma porfiriano: historia del desagüe del Valle de México*. Mexico City: UNAM-PUEC-ISS.
- Perló Cohen, M., & González Reynoso, A. E. (2005). *¿Guerra por el agua en el Valle de México? Estudio sobre las relaciones hidráulicas entre el Distrito Federal y el Estado de México* (1st ed.). Mexico City: UNAM-Fundación Friedrich Ebert.
- Pradilla Cobos, E. (2004). Ciudad de México: los caminos de privatización de lo urbano. *Ciudades*(54-62), 57.
- Rancière, J. (2013). *The politics of aesthetics : the distribution of the sensible*. London: Bloomsbury Academic.
- Reis, N. (2014). Coyotes, Concessions and Construction Companies: Illegal Water Markets and Legally Constructed Water Scarcity in Central Mexico. *Water Alternatives*, 542-560.
- Richardson, T., & Weszkalnys, G. (2014). Resource Materialities . *Anthropological Quarterly*, 5-30.
- Rivera, D. (1952). Plastic Integration in the Lerma Water Distribution Chamber. Theme: Water. Origin of Life on the Earth. *Espacios*, 9.
- Rodríguez Kuri, A. (2012). *Historia política de la Ciudad de México (Desde su fundación hasta el año 2000)* (1st ed.). Mexico City: El Colegio de México.
- Romero Lankao, P. (1999). *Obra hidráulica de la Ciudad de México y su impacto socioambiental, 1880-1990*. Mexico City: Instituto Mora.
- Romero Lankao, P. (2010). Water in Mexico City: what will climate change bring to its history of water-related hazards and vulnerabilities? *Environment & Urbanization*, 22(1), 157-178.
- Rosales García, A. (2015). *Economía política del servicio de agua y saneamiento en la ciudad de México*. Mexico City: COLMEX [PhD Dissertation].
- Roy, A. (2005). Urban informality: Toward an epistemology of planning. *Journal of the American Planning Association*, 71(2), 147-158.
- Rozental, S. (2014). Stone Replicas: The Iteration and Itinerancy of Mexican Patrimonio. *Journal of Latin American and Caribbean Anthropology*, 331-356.
- SACMEX. (2018). *Diagnóstico, logros y desafíos*. Mexico City: SACMEX.
- Sánchez-Mejorada Fernández, M. C. (2005). *Rezagos de la modernidad: memorias de una ciudad presente*. Mexico City: Universidad Autónoma Metropolitana.
- Schindler, S. (2017). Towards a paradigm of Southern urbanism. *City: analysis of urban trends, culture, theory, policy, action* , 21(1), 47-64.

- Schwarz, A. (2017). *Demanding Water: A Sociospatial Approach to Domestic Water Use in Mexico City*. Stuttgart: Steiner Franz Verlag.
- Schwenkel, C. (2018). The Current Never Stops: Intimacies of Energy Infrastructure in Vietnam. In A. Gupta, N. Anand, & A. Hannah (Eds.), *The Promise of Infrastructure* (pp. 102-131). London: Duke University Press.
- Scott, J. C. (1998). *Seeing like a state : how certain schemes to improve the human condition have failed*. London: Yale University Press.
- Secretaría de Recursos Hidráulicos. (1948). Obras del Valle de México. *Ingeniería Hidráulica en México*, II(2), 227-240.
- Silver, J. (2014). Incremental Infrastructures: material improvisation and social collaboration across post-colonial Accra. *Urban Geography*, 35(6), 788-804.
- Silver, J. (2015). Disrupted Infrastructures: An Urban Political Ecology of Interrupted Electricity in Accra. *International Journal of Urban and Regional Research*, 39(5), 984-1003.
- Silver, J., & Meth, P. (2018). *Speculative Infrastructures and cities-in-the-making. A workshop magazine*. Sheffield: Urban Geography - Urban Institute/SIID at the University of Sheffield - Leverhulme Trust. Retrieved from <https://urbangeographyjournal.files.wordpress.com/2019/02/speculative-infrastructures-a-workshop-magazine.pdf>.
- Simone, A. (2004a). *For the City Yet to Come: Changing African Life in Four Cities* (1st ed.). Durham, NC: Duke University Press.
- Simone, A. (2004b). People as Infrastructure: Intersecting Fragments in Johannesburg. *Public Culture*, 407-429.
- Simone, A. (2013). Cities of Uncertainty: Jakarta, the Urban Majority, and Inventive Political Technologies. *Theory, Culture & Society*, 30(7/8), 243-263.
- Smith, N. (2008). *Uneven development: nature, capital and the production of space*. Athens, GA: University of Georgia Press.
- Star, S. L. (1999). The Ethnography of Infrastructure. *American Behavioral Scientist*, 377-391.
- Stoler, A. L. (2002). Colonial Archives and the Arts of Governance. *Archival Science*, 2(1-2), 87-109.
- Stoler, A. L. (2009). *Along the Archival Grain: Epistemic Anxieties and Colonial Common Sense*. Princeton, NJ: Princeton University Press.
- Strebel, I. (2011). The living building: towards a geography of maintenance work. *Social & Cultural Geography*, 243-262.
- Swyngedouw, E. (1996). The city as a hybrid: On nature, society and cyborg urbanization. *Capitalism Nature Socialism*, 7(2), 65-80.
- Swyngedouw, E. (1999). Modernity and Hybridity. *Annals of the Association of American Geographers*, 443-465.
- Swyngedouw, E. (2004). *Social power and the urbanisation of water: flows of power*. Oxford: Oxford University Press.
- Swyngedouw, E. (2006). Circulations and metabolisms: (Hybrid) Natures and (Cyborg) cities. *Science as Culture*, 15(2), 105-121.

- Swyngedouw, E. (2015). *Liquid Power: Contested Hydro-Modernities in Twentieth-Century Spain*. Cambridge, MA: The MIT Press.
- Tenorio Trillo, M. (1996). 1910 Mexico City: Space and Nation in the City of the Centenario. *Journal of Latin American Studies*, 75-104.
- Tonkiss, F. (2015). Afterword: Economies of infrastructure. *City*, 384-391.
- Tortolero Villaseñor, A. (2000). *El agua y su historia: México y sus desafíos hacia el siglo XXI*. Mexico City: Siglo XXI Editores.
- Tostado Gutiérrez, C. (2012). *El agua, origen de la vida en la tierra. Diego Rivera y el Sistema Lerma* (1st ed.). Mexico City: Arquine - Museo de Historia Natural y Cultura Ambiental.
- Valenzuela, A. (2007). Santa Fé (México): Megaproyectos para una ciudad dividida. *Cuadernos Geográficos*(40), 53-66.
- Valenzuela, A. (2013). Dispositivos de la globalización: la construcción de grandes proyectos urbanos en Ciudad de México. *EURE. Revista Latinoamericana de Estudios Urbano Regionales*, 39(116), 101-118.
- Vargas Parra, D. (2012). Apuntes para la iconografía de un mural. In C. Tostado Gutiérrez (Ed.), *El agua, origen de la vida en la tierra. Diego Rivera y el Sistema Lerma* (pp. 61-77). Mexico City: Arquine - Museo de Historia Nacional y Cultura Ambiental.
- Villenave. (1945, March 8). Están muy Adelantadas las Obras Para Traer Agua del Río Lerma. *El Universal*.
- Vitz, M. (2018). *A City on a Lake: Urban Political Ecology and the Growth of Mexico City*. London: Duke University Press.
- Vizcaino, F., & Bistrain, P. (1952). Problemas generales del Valle y de la ciudad de México. Importancia del aprovechamiento integral de los recursos hidráulicos de nuestros volcanes en generación de energía y abastecimiento de agua potable para el Valle y la Ciudad de México. *Ingeniería Hidráulica en México*, VI(1), 12-39.
- von Schnitzler, A. (2008). Citizenship Prepaid: Water, Calculability, and Techno-Politics in South Africa. *Journal of Southern African Studies*, 899-917.
- von Schnitzler, A. (2013). Traveling technologies: Infrastructure, ethical regimes, and the materiality of politics in South Africa. *Cultural Anthropology*, 670-693.
- von Schnitzler, A. (2016). *Democracy's Infrastructure: Techno-Politics and Protest after Apartheid* (1st ed.). Oxford: Princeton University Press.
- Watts, J. (2015). *Mexico City's water crisis – from source to sewer*. Retrieved December 14, 2018, from <https://www.theguardian.com/cities/2015/nov/12/mexico-city-water-crisis-source-sewer>
- Wester, P. (2009). Capturing the waters: the hydraulic mission in the Lerma-Chapala Basin, Mexico (1876-1976). *Water History*, 9-29.
- Wittfogel, K. A. (1957). *Oriental despotism: a comparative study of total power*. New Haven, CT: Yale University Press.
- Worster, D. (1986). *Rivers of Empire: Water, Aridity, and the Growth of the American West*. New York: Pantheon Books.
- Zeiderman, A. (2013). Living Dangerously: Biopolitics and urban citizenship in Bogotá, Colombia. *American Ethnologist*, 71-87.

Zeiderman, A. (2016). *Endangered City: The Politics of Security and Risk in Bogotá*. Durham, NC: Duke University Press.