Infrastructures and practices: networks beyond the city

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Introduction

Big infrastructures are complicated to design and operate and expensive to build and maintain. They have other features too, but these are the characteristics that dominate academic research and writing in science and technology studies, in urban and social theory and in various forms of historical and economic geography.   Across these disciplines common projects include those of showing how infrastructures are variously shaped by forms of urban and regional governance, by local and national politics and by the aspirations of city planners, engineers and entrepreneurs. In analysing these processes some commentators focus on the conflicts and tensions involved. Others highlight inequalities arising from the radically different forms of provision that characterise cities in different parts of the world. Meanwhile, for those interested in sustainability, urban infrastructures represent important sites of actual or potential renewal and of transition towards more efficient or lower carbon regimes.   Together, these and other such lines of enquiry constitute diverse but nonetheless skewed traditions in which matters of provision and supply take centre stage.

For various reasons there is much less academic debate about what infrastructures are *for*, or about the constitutive but also complicated relation between infrastructures and the patterns of consumption and practice they sustain.[1] In making the case for paying more concerted attention to infrastructures-in-use, I make the case for analysing the various ways in which they are implicated in the emergence, the disappearance and the cultural and spatial circulation of an array of social practices. In what follows I explore three themes that come to the fore when the agenda is turned around in this way.   The first concerns the co-evolution of infrastructures and practices – a topic I consider with reference to a short stretch of road. The second has to do with the relation between infrastructures and the diffusion of social practices, here explored with reference to wiring and electric refrigeration. My third example, relating to cycling and driving, illustrates forms of obduracy and flexibility in what roads are and in how they are used. In combination, these three cases provide new insight into the spatial and temporal dynamics of infrastructures-in-use.

This method of approaching infrastructures as living systems, and as systems that are integral to the circulation and to the emergence and dissolution of different aspects of daily life has a number of intriguing consequences. In the context of this book, two are especially important. First, it is evident that distinctions between networked, post-networked or pre-networked cities fail to capture the multiple layering and historical co-existence of different possible conjunctions of infrastructures and practices. Second, when focusing on infrastructures-in-use, and hence on demand as well as supply, the city does *not* figure as an especially meaningful or self-evidently relevant point of reference. Instead, it becomes more important to see infrastructures as material and institutional arrangements through which complexes of social practice are constituted at various scales. This is not to deny their localised, materialised existence but it is to highlight the large, spatially extended social phenomena of which infrastructures are also, and necessarily a part.

In bringing the chapter to a close I suggest that it is useful to distinguish between the geographies and politics of infrastructures-in-the-making and of infrastructures-in-use (Edgerton 1999).   In particular, this distinction enables us to see trends and processes that are obscured by approaches in

which infrastructural reconfiguration is conceptualised as a form of *urban* change. Before developing these ideas in any detail I begin by briefly reflecting on why infrastructures, many of which depend on complex forms of interconnection, have been analysed as distinctly urban phenomena.

Infrastructures as urban phenomena: priorities and preoccupations

In many ways it is odd to even question the urban focus of infrastructural research. On a number of counts it would be fair to say that infrastructures are *inherently* urban. In purely practical terms, the flow of materials into and out of densely populated areas calls for a level of organisation and management that does not pertain in other settings. This feature generates a host of interesting questions about how cities, as especially demanding sites of consumption, relate to surrounding hinterlands of resource production and of waste management. In addressing these questions it is impossible to overlook the fact that infrastructures – whether of water, road, rail, power or waste – are implicated in the social and economic ordering of urban-rural relations.

A second also obvious point is that cities are uniquely suited to infrastructural innovation, providing entrepreneurs with greater opportunities for profit than could ever be imagined or achieved in the countryside. As Harrison's work on the development of electricity in the USA demonstrates, issues of urban scale and density proved crucial for the flow of finance and for the economic calculations and rationalities involved in constructing profitable power stations and in handling fluctuations in electrical supply and demand (Harrison 2013).

In short, cities need infrastructures, cities enable infrastructures and in histories of infrastructural development, cities prove to be important actors in their own right (Schott 2010). In his beautifully crafted account of electrification in Western society, Hughes (1993 [1983]) compares the first forms of electrical provision, showing how these developed within Berlin, London and Chicago. Whilst his work is in part about how knowledge circulated and travelled between experts and engineers, it is also about how networks were shaped by necessarily localised city-specific histories and politics. Though dealing with other systems and places, authors including Rosen (1986), Guy, Marvin et al. (2001) and Coutard and Hanley (2005) contribute to this tradition, countering overly simple narratives of technological diffusion by showing that the historical development of infrastructures differs from one city to the next.

Today, as in the past, the urban is where the action lies. Every way we look, cities matter: they are the hubs around which road, rail and air transportation revolve; they are the nodes of which more extensive grids are made; they are the destinations to and through which cables are routed.

Despite all this I want to argue that as topics of academic analysis and enquiry, cities and infrastructures are not obvious, natural or necessary bedfellows. On reflection, the seemingly self-evident connections outlined above are better understood as outcomes of a distinctive and somewhat narrow approach. Brenner addresses much the same issue in a recent discussion of how "the urban" is mobilised in academic discourse. In an article entitled *Theses on Urbanization*, he contends that the "'unit-like' character of the urban" should be "understood as a structural product of social practices and political strategies, and no longer their presupposition" (Brenner 2013: 109). So what are the analytical and practical, political strategies that lie behind methods of conceptualising urban and infrastructure in the same frame?

Writing about networked and post-networked cities, about "splintering urbanism" (Graham and Marvin 2001) and cities as sites of infrastructural transition (Hodson and Marvin 2009) makes sense *if* we are in essence interested in methods of organising and governing the hardware of urban metabolic systems. It makes sense *if* we take city authorities and planners to be key actors and gatekeepers, capable of promoting or stemming innovation and it makes sense *if* we are above all interested in the economics and practicalities of provision. It should come as no surprise that people

who work in schools of planning, architecture, urban geography and design *are* interested in pursuing these questions. For them, the discursive framing of urban and infrastructure figures as an enabling device: it permits significant debates to be had about how and where roads, power and water supplies are built, about urban governance, and about the consequences and future implications of such arrangements for issues of resource consumption, access, equity and justice (Bulkeley, Broto et al. 2012).

But if these are *not* the questions we want to follow then the urban focus, as mobilised above, is something to be overcome, re-worked or worked around. As Brenner observes, other concepts and terms are required to show how forms of accumulation and spatial regulation "cascade along intercontinental transportation corridors; large-scale infrastructural, telecommunications, and energy networks" (Brenner 2013: 88). When abstracted from the city and reinserted in the borderless world of business, infrastructures reappear as opportunities for financial gain, for transnational innovation, and for increasing market share. With these questions in mind, different features of the city pop into view: if you look down as you walk along many streets in Europe you will discover that the manufacture of simple elements like manhole covers is dominated by a handful of companies.[2] To give another example, conceptualising infrastructures as sites of regional political cohesion (Hård and Misa 2008) or of international tension and conflict (Collier and Kemoklidze 2014) calls for a repertoire of non-urban terms borrowed from neighbouring fields like those of politics and international relations. Further methodological challenges arise when looking at infrastructures not as networks in their own right, but as material arrangements that are integral to the conduct of daily life and that are enmeshed in the ongoing dynamics of social practice – that is to doing things like travelling to work, lighting and heating homes, keeping food cool and so forth. What terms and spatial scales should we work with in conceptualising and understanding infrastructures-in-use?

Following Brenner, I agree that an emphasis on social practice calls for new ways of conceptualising the "*patterning* of modern sociospatial landscapes" (Brenner 2013: 95). But what does this involve and where should we begin? The rest of this chapter attempts to address these questions, first commenting on the relation between infrastructures and practices in general terms and then working through a series of more specific questions with reference to a selection of empirical cases and examples.

Infrastructures and social practices

At one level, the relation between infrastructures and the range of social practices enacted in contemporary society is direct and simple. Road and rail systems matter for how and when people travel and for where they go; mains water is an integral element of daily showering and of washing with an automatic machine; electric power is significant for all manner of activities including forms of entertainment, communication, lighting, cooking, and so forth. The snag is that observations like these tell us little about *how* infrastructures constitute and are in turn outcomes of daily life.

Fortunately, the literature on social practice theory provides some clues. Within this literature, social practices are generally defined as entities that exist across space and time (Giddens 1984). A practice is thus something that persists beyond any one moment of enactment; it is socially shared, and it involves the active integration of a range of constitutive elements including meanings, forms of competence and materials.   From this point of view, practices have recognisable 'lives' of their own: they circulate and travel, and they emerge, endure and disappear.   In addition, some of these dynamic processes relate to the ways in which practices interact with each other and to how bundles or complexes of practice hang together (Shove, Pantzar et al. 2012).

Thinking about how infrastructures relate to the lives of practices, so defined, is clearly not a matter of understanding instances of individual user behaviour, or of quantifying demand for the resources and services that infrastructures deliver. Instead, and as illustrated below, understanding the various

interconnections involved calls for a more subtle account of the historical co-evolution and spatial distribution of infrastructures, resources and the devices and appliances on which different practices depend (Watson 2012).

In approaching this topic there are several generic features to bear in mind. One is that infrastructures typically enable many practices at once. This is important for the ways in which infrastructural histories have been, and might be organised. Although there are numerous excellent accounts of infrastructures-in-the-making, these singular narratives are rarely matched by parallel analyses of the necessarily *multiple* transitions in practice that are also entailed.

To elaborate, the electrification of western society depended on a whole lot more than the reliable provision of electric power. It also required the electrification of a multitude of social practices, each differently transformed by the introduction of some new device, and by the consequent reconfiguration of competence and meaning. As Cowan reports, electric washing machines made a real difference to the cultural significance of doing the laundry and to the skills involved (Cowan 1983). Electric cookers also transformed methods and habits of food preparation, but not in the same way. To complicate matters, a number of social practices, and a number of material elements/appliances, rely on the co-existence of several infrastructures at once. Whether multiple systems are involved or not, the key point is that accounting for infrastructures-in-use calls for a detailed and differentiated understanding of how diverse social practices are reconfigured.

A second also generic feature is that the relation between social practices and infrastructures is almost always mediated by 'appliances' by which I mean things like computers, refrigerators, cars, bikes, showerheads etc. This is important for how infrastructures and practices influence each other and for how such relationships might be revealed.

The fact that relations between infrastructures and practices are multiply mediated means that there is (consequently) scope for substitution, adaptation and dislocation. The 'same' practices can be enacted in much the same way despite sometimes significant differences in how resources and services are provided. As a result, changes in infrastructural arrangements (e.g. from centralised to decentralised power supply, or from local to more distant forms of water treatment etc.) are unlikely to show up *in* practice unless they affect the 'proper' functioning of one or more mediating devices. By the same token, individual practices and mediating devices/appliances may well change, sometimes radically so, but with little or no tangible impact on the infrastructures on which they multiply and variously depend. Amongst other things, this means that analyses of the relation between infrastructures and practices need to consider the *mediating* function of appliances – broadly defined. As material elements of practice, appliances are implicated in the stability of what people do, and in how that changes (Shove, Pantzar et al. 2012). They also constitute what we might think of as the sensitive tips of the infrastructures to which they connect: defining both the extent and the patterning of demand, and the institutional and material configuration of supply.

A third feature, again related to the mediated character of infrastructure-practice relations, is that there are likely to be different, but co-existing forms of adaptation on the one hand and obduracy on the other. In other words, infrastructures and complexes of practice can change at different rates and in different directions. For example, canal systems built for freight, are now important sites of leisure. There have certainly been changes, including major programmes of restoration, but the point is that the basic hardware, including material arrangements of locks, bridges, towpaths etc., is capable of sustaining really very different forms and patterns of use.

In combination, these comments indicate that understanding infrastructures-in-use depends on understanding the ongoing dynamics of different practices, and the range of material elements through which infrastructural relations are mediated and made. These ideas provide a basis from which to consider methods of addressing three more specific questions: How do infrastructures and

practices co-evolve? How do infrastructures enable the circulation of practices, and how do infrastructures relate to changing complexes of practice? The challenge of analysing and representing these different aspects calls for some methodological ingenuity and for creative thinking about how to define infrastructure-in-use and identify relevant processes of change. It is obvious that conventional methods, like those of tracking the various actors with a stake in managing and governing networks of one kind or another will not do, so what other approaches might we take?

The next three sections explore different ways of responding to the questions outlined above. The first strategy is to pick on a specific location – a bend in a road – and consider the co-evolution of infrastructure and practice from that one spot. The second is to focus on a process: to ask how food is cooled and to take that as a way into the analysis of infrastructure-practice relations. The third is to take stock of how an 'unchanging' infrastructure (the UK road network) accommodates overlapping and rival practices.

These exercises and examples should not be interpreted as historically significant case studies in their own right or as means of illustrating what I take to be generic trends and processes. Instead, each is designed and written with the aim of articulating particular features of the mutually constitutive relation between infrastructures and social practices. As becomes obvious, in putting these accounts together I have foregrounded aspects of materiality and have done so at the expense of other crucial media through which infrastructures and practices interact.[3] This is evidently not the only way to go, but it is a way that allows me to capture and conceptualise the spatial and temporal dynamics of infrastructures-in-use.

How do infrastructures and practices co-evolve?

This question led me to a section of road some 70 km south of London. Other stretches would do as well but the piece I have selected is especially well documented. At the point where the current A3 passes underneath a village called Hindhead and behind an impressively steep valley called the 'Devil's Punch Bowl' there are in fact three co-existing versions of the same road. The first version, which was the original 'Portsmouth Road', was re-routed by the Kingston-upon-Thames to Sheet Bridge Turnpike Company in 1826 to provide a gentler incline for the many horses and wagons that used it. The original steeper route (the old A3) remained as a rough pedestrian track. As cars replaced horses the sharp bend around the head of the valley became notoriously dangerous: for a time the A3 had 40% more traffic accidents than other roads of its grade. There were numerous attempts to solve this problem including cutting the road deeper into the hillside (in 1968) but in 2011 what was by then the last remaining stretch of single carriage way was finally abandoned. Some 20-30,000 vehicles a day[4] now speed along the 'new' A3 and through the Hindhead tunnel. The tunnel, which is by all accounts a triumph of modern engineering (Stafford 2013)[5] is also an outcome of more than thirty years of transport planning, and a final answer to years of local and national controversy. At a cost of £386 million for just 1.83 km it is the second most expensive piece of road (per metre) ever constructed in Britain.

To summarise, the Portsmouth road (the old A3) was paved with stone and when it was first abandoned it became a path for walking, not for horse drawn traffic or for cars. The second A3 was re-routed for the horses, surfaced with tarmac, upgraded and then abandoned. Having been covered with earth from the tunnel excavation it is now turning back to heath land. Meanwhile, the new A3 runs underground, an expensive route designed to reduce accidents, ease congestion and provide a fast dual carriageway from London through to Portsmouth.

All three forms certainly counts as infrastructure, but how do they relate to changes in social practice? One answer is that the three A3s are outcomes of successive, generic, transitions from walking on foot to the use of horse drawn carts, (hence the need for a gentler incline), and from a

regime of wagons (Sturt 1923) to a fast moving system of automobility. These developments are inseparable from innovations in the production and ownership of cars, the diffusion of driving skills and changing patterns both of work and leisure. More abstractly, patterns of mobility constitute and are occasioned by the changing organisation of space and time: the A3 today is thus part of an historically and geographically specific patterning of origins and destinations including forms of commuting and of leisure, in this case, involving week-ends spent at the seaside.

More immediately, the A3 simultaneously enables and depends upon connections to other roads and places. It is used for local and for long distance journeys and is not only or singularly a road to Portsmouth. At the same time, it is not 'any' road: the details of the route reflect the movement of people and goods between London and Portsmouth, a major harbour and naval base on the South coast. Furthermore, the specificities of the local geology matter hugely. Less obvious, but also important, the A3 in use depends on other 'local' infrastructures including the London-Portsmouth railway which opened in 1858.

Looking down from the head of the Punch Bowl, we can see the different incarnations of the A3, and its presently co-existing forms, and we can see that these simultaneously figure as a) elements in certain localised performances of generic practices (walking, driving a wagon and horses, travelling by car), b) elements of a much more extensive road network that facilitates multiple forms of living, working and moving around and c) parts of infrastructure that are constantly over-written by changing configurations of daily life. From this point of view, the A3 (or more precisely, the three A3s) provides some insight into the persistently dynamic relation between infrastructures-as-material-arrangements and infrastructures-in-use.

How do infrastructures enable practices to circulate?

I now turn from a discussion of the co-existence and successive transformation of infrastructures and practices, as revealed from the vantage point of one location, to an exercise which is primarily concerned with processes of diffusion and circulation. I also turn from roads to networks of electric power, focusing on the relation between electrification, the availability of freezers and refrigerators, global systems of food provision and changes in cooking and eating.

Infrastructures typically link dispersed people and practices. In the case of electricity, the scale of interconnection varies: relatively de-centralised systems exist alongside highly integrated grids. However, the general pattern is one in which the output from one or more power stations is *distributed* to multiple, disparately located consumers. Although distribution is integral to these arrangements, there is relatively little academic literature on the central role of wire, miles of which were involved in making even simple city-centric systems of power supply. This is surprising in that the economics of distribution, themselves closely related to issues of density and topography, proved crucial for the directions and rates at which electrification proceeded and for the very different calculations involved in taking electricity to rural areas (Harrison 2013).

In practical terms, the challenges of developing high and low voltage transmission systems called for innovations in engineering and for significant investment in labour and specialist expertise, not to mention raw materials. In dealing with the hazards of lightning strikes, frost and ice, thermal differential and sagging cables, those involved developed methods of extending the distance between sites of production and consumption. These forms of spatial extension are integral, and not incidental to the making of a functioning infrastructure, and to the project of establishing a network the tentacles of which now reach far and wide.

Wiring and in particular that involved in long distance 'point to point' transmission figures in Hughes' account of how distant power sources (hydropower) were conveyed to urban centres of consumption (Hughes 1993 [1983]). Nye also writes about how the first industrial connections

established a network of cables that facilitated further extension to domestic consumers (Nye 1992). However, neither foreground the importance of distribution for the circulation of power, and neither follow wires as they cross thresholds, threading their way through walls and ceiling spaces, and into the fabric of the home. Despite being vital for systems of electric power and for the daily operation of the grid, homes and workplaces are hardly ever thought of as part of the infrastructure itself (Patterson (2008) is a notable exception). Although largely unnoticed by those who analyse the 'big' infrastructures of the day, innovations in this area include the provision of an increasing number of power sockets[6] and extension cables, each connected to an also increasing number of appliances.

The question of how this extensive diffusion of power translates into the practices of daily life is complicated not least because electricity (mediated by a multitude of appliances) has many uses. Rather than considering this topic in general, I zoom in on freezing and refrigeration. Electrically powered fridges and freezers represented a step change in the production and distribution of food, and in habits of cooking and eating. As such they illustrate the part that infrastructures play in separating sites of consumption and production and in the same move enabling the circulation and diffusion of new practices.

Previously important methods of keeping food cool, including the use of ice or of larders, were not sufficiently consistent, nor sufficiently widespread to enable what is now described as the "cold chain". The cold chain depends on an unbroken series of spaces, from sites of production, through to transportation, retailing and the home itself that are maintained at set temperatures. The global food industry, which is now thoroughly reliant on the cold chain, is also thoroughly dependent on the very widespread, very reliable diffusion both of electrical power and of fridges and freezers.

Accounts of how refrigerators were first developed (Cowan 1985), and of their changing role in the home (Shove and Southerton 2000) swing between narratives of technological innovation and innovation in the organisation and management of food provisioning. Initially used to 'beat the seasons', and preserve gluts of home grown food, refrigerators and freezers acquired new roles alongside the commercial use of cold storage and the supply of ready-frozen food via supermarkets (Hand and Shove 2007). In Friedberg's words, "the very rhythms and geographies of daily life changed … as the cold chain reached from the markets and shops into consumers' kitchens." (Freidberg 2014: 8). As the cold chains of food provisioning have extended, so the 'need' for this particular appliance and for the electricity to power it has grown. One consequence is that fridges have risen to third position in the list of priorities for the poorest of electrified households (after lighting and a television) (McNeil and Letschert 2009). Fridges do not, of themselves, change practices of eating and cooking, but in constituting and contributing to wider systems of provision, they have led to the emergence and diffusion of what Garnett refers to as forms of refrigerator dependence (Garnett 2007: 78).

As represented here, the spatially distributed character of the electricity infrastructure enabled transformations in the spatially distributed character of food provisioning, facilitating the emergence and circulation of new fridge-related practices (bulk buying, ready-meals, fast food, eating seasonal products all year round, etc.). In making freezing possible around the world, the widespread availability of electric power (up to, and including the wiring of the home) has arguably enabled the development and persistence of systems of food provision in which consumers are again distanced from sites of production. In this it has enabled the circulation not only of food products, but also of tastes, habits and skills.

This example highlights the extent to which infrastructures sustain each other, impacting on commercial and domestic practice, not in isolation but in combination. As Freidberg notes, changes in methods of food supply depended on electric power, on the widespread diffusion of refrigerators *and* on expanding transportation networks (Freidberg 2014). As with the 3A3s, infrastructures and

practices co-evolve, but in this case on a global scale. In effect, the distribution of electric power enables the circulation of other goods and appliances, doing so in ways that reconfigure geographies of consumption and production. One practical consequence, illustrated here through an account of the interweaving of power lines, household wiring, cold chains, and the fridge itself, is that the 'need' for electricity becomes embedded not just in one location, but everywhere.

How do infrastructures relate to changing complexes of practice?

This far I have underlined the extent to which practices and infrastructures depend on each other, whether at one location, or across many. For example, I have suggested that systemic transitions in mobility and in the social arrangements that underpin the movement of things and people in space and time depend on, and occasion, the sequential 'upgrading' of the A3. I have also underlined the co-dependence of freezer/refrigerator reliant complexes of shopping, cooking and eating and related networks of electricity and of frozen space. In both cases it is important to appreciate the two-way nature of these connections: there would be no need for the A3 tunnel, if the road was only rarely used; likewise, the ongoing reproduction of the frozen-food chain absolutely depends on millions of people buying and cooking frozen foods. My third example complicates this account.

As already mentioned, infrastructures routinely sustain many practices at once.   Because of this multiple anchoring, and because of the heavy weight of materiality that is often involved, infrastructures frequently outlive at least some of the practices around which they were designed. Similarly, the mere provision of relevant infrastructure does not guarantee that specific practices will, in fact, take hold or endure. To illustrate these ideas I consider the changing relation between cycling and driving.

The development of cycling as a normal means of transport laid the foundations for many of the elements on which the coming system of automobility depended, including relatively smooth well surfaced roads (Geels, 2005). While the A3 has changed course, the much more common situation is one in which routes remain the same and in which roads are repeatedly repaired and re-surfaced. From this point of view, they constitute relatively enduring, relatively obdurate forms of material infrastructure.   However, the same cannot be said of roads-in-use. In the UK in the 1930s "approximately one fifth of men cycled to work, and around one tenth of women."(Pooley and Turnbull 2000: 19). According to the UK Cabinet Office, "the *annual distance* cycled fell from 23 billion kilometres (13% modal share) to 5 billion kilometres (1% modal share)" between 1952 and 1970 (Cabinet Office Strategy Unit 2009: 15). As these few figures indicate, the road infrastructure is not as strongly tied to the practice of cycling as it once was (Shove 2012).

One obvious explanation has to do with the car (Watson 2012). In so far as cycling and driving have elements in common (e.g. the road) improvements in this shared infrastructure promise to enhance the development of both. On the other hand, these common elements may prove to be crucial sites of competition: as roads become busier (i.e. filled with cars), cyclists are quite literally edged aside. From this point of view, the changing character of the road infrastructure-in-use is a consequence both of the development and diffusion of automobility, and the decline in cycling.

Many of the necessary elements of cycling endured but during the 1960s and 1970s it seems that the links which held cycling in place as a normal means of transport for the many, and not just for a few, broke apart. This trend was not confined to the UK. Pucher and Buehler note that levels of cycling dropped massively between the 1950s and 1970s across much of Europe. To quote: "From 1950 to 1975, the bike share of trips declined by roughly two-thirds in a sample of Dutch, Danish and German cities." (Pucher and Buehler 2008: 502). However, not all fell as far as they did in the UK, and in some countries the bike share of trips has since risen by as much as 20%. As a result, rates of cycling within Europe currently differ by a factor of ten – ranging from an average of 0.2 km per day in the UK to 2.5 in the Netherlands (Pucher and Buehler 2008: 497).

This is odd in that cars are no less established in the Netherlands than in UK. In thinking about where the difference lies, de la Bruheze suggests that although levels of cycling also fell spectacularly in the Netherlands, the idea of cycling as normal retained its grip on the public consciousness. Dutch transport planners consequently hung on to the idea that roads should be for bikes as well as for cars and acted accordingly (de la Bruheze 2000). This was apparently not the case in the UK where rates of cycling dropped so low that for a time cyclists' needs were not provided for at all: indeed some policies were designed to drive them from the road. The point here is that changing *practices* are of consequence for infrastructures-in-use, and that changes in how infrastructures are used are, in turn, of consequence for future planning and investment in infrastructures-as-structures.

That said, infrastructures and practices do not correspond, one to one. Likewise, local forms of infrastructural provision do not determine the longer term evolution of practices like cycling. It is consequently possible to find bits of infrastructure that were designed with cyclists in mind but that are no longer, or that have perhaps never been used. Stevenage, a new town developed not far from London in the late 1950s, has 26 miles of segregated cycleway built to allow residents to pedal back and forth between home, work or school. Some of these routes are still in use, but none carry the volume of cycles for which they were designed. In this case the local infrastructure is in place but for reasons that have to do with changing patterns of mobility and with trends that extend well beyond Stevenage itself, the practice is missing.

As this example shows, and as already mentioned, infrastructures and the multiple practices they enable co-exist in ways that are complicated, contested and sometimes in conflict. Second, and as indicated above, it is possible to find different combinations of obduracy and innovation. These include instances in which practices persist in the absence of suitable infrastructures, and in which infrastructures outlast or fail to engender the practices for which they were constructed. Such otherwise puzzling situations make sense provided we think of infrastructures not as physical, geographically bounded entities, but as elements in more extensive and also more dynamic transitions in practice. From this point of view, roads constitute material elements that are both part of the practices they sustain, and that are, at the same time, partly constituted by those same practices (Shove, Pantzar et al. 2012).

Discussion

The strategy of analysing infrastructures-in-use as opposed to infrastructures-in-the-making has allowed me to catch sight of the co-existing scales across which infrastructures act. Amongst other things, this method positions infrastructures as systems of *connection* – variously providing links between sites of production and consumption, between one location (London) and another (Portsmouth), and between co-existing bundles and complexes of social practice (shopping, eating, cooking).

I have worked with a selection of examples, each chosen to illustrate a different facet of infrastructure-practice relations but in none of these has the city been an obvious starting point. Instead, all three suggest that road infrastructures, cold chains and networks of power are usefully and appropriately conceptualised as material arrangements that enable the emergence and diffusion of practices that are socially and spatially extended. The idea that infrastructures (and parts of them) are involved in reproducing what Schatzki terms 'large' social phenomena makes a lot of sense (Schatzki 2011). Ironically, it also helps make sense of how urban environments change. It does so in that city planners and authorities 'want' infrastructures not for their own sake but because they enable citizens to reproduce practices and ways of life that are valued and desired and that exist *elsewhere.*

When viewed as material entities, infrastructures have definite though sometimes distributed coordinates. They are possible to map, locate and find. By contrast, the spatial ranges and registers

that apply to infrastructures-in-use are inherently fluid, being defined by the always shifting outlines of specific social practices, and/or constellations of practices. This is complicated by the mediated character of the relationship between infrastructure and practice. Since electricity is (now) needed for refrigeration the geographical distribution of power is important, but electricity alone does not make food cold: for this a fridge is also required. The diffusion of appliances, and of home wiring, is therefore also part of the story. In addition, places where fridges and power are present constitute links in cold chains through which consumers, producers and retailers are actually or potentially connected around the world. On top of this we might also consider the circulation and changing contours of knowledge (how do skills in handling frozen food develop and change?) and of diet: what does the fridge contain, and to which culinary traditions does it contribute? To reiterate, infrastructures-in-use have no firm spatial coordinates, but are instead determined by the layering and overlaying of the various elements of which specific practices are made – and at this point it is important to remember that infrastructures typically enable many practices at once.

Despite this diversity, despite the fact that any two locations are likely to be served by co-existing infrastructures of very different vintage, and despite real inequalities of access, European cities have much in common. One way or another electricity, mains water, regular waste collection, sewerage systems, telephones, parking spaces and internet connections are increasingly available as standard. This standardisation (together with standardisation in home appliances) is such that practices of urban living appear to be converging *regardless* of the networked or post-networked arrangements on which they depend, and regardless of the hugely varied combinations of commercial, regulatory and state interests that lie behind. Hård and Misa view these trends with horror, arguing that previously distinct urban identities are being eroded by a "menace of creeping homogenisation" (Hård and Misa 2008: 5). Others take a more positive view but either way there is agreement that behind the scenes, common standards of infrastructural provision constitute new forms of spatial and cultural interconnection.

Discussions of this kind are routinely suppose that in one way or another, infrastructures enable forms of social and practical convergence. Another option is to think about how past and present complexes of social practice shape the infrastructures on which they also depend. From this point of view, ambitions like those of taking a daily shower have impelled people to upgrade electric circuits, add pumps, rip out cupboards and do whatever is necessary to make showering possible. Similar work goes on at a macro scale: grids are reinforced, motorways are widened, and tunnels built in order to cater for an array of underspecified, overlapping and interlinked complexes of practice. Forecasts of future demand are routinely organised around units of resource (litres of water, barrels of oil) or of service (passenger kilometres travelled), and as such they skate over the different dynamics of practice on which summary estimates implicitly depend. It is nonetheless the case that at every scale, infrastructures (as forms of hardware) are made and mended in anticipation of multiple future practices, not all of which transpire. This means that as grounded, materialised entities, infrastructures are also full of imagination, embodying and carrying ideas and visions of welfare, well-being and profit[7] that circulate and extend far beyond the spots in which they are built.

In conclusion, the intellectual challenges around which this book is organised are consistent with a tradition which deals with urban infrastructures-in-the making and in-the-reconfiguration. In this context, it is appropriate to compare dominant and alternative models of infrastructure supply and to consider these processes within and as part of a corresponding dynamic of "urban change". Up to a point it is possible to include patterns of use and demand within this frame. But if we are to really get to grips with the reconfiguration of infrastructures-in-use, the city is *not* an especially meaningful point of reference.

As described above, the forms of socio-spatial patterning that arise from the changing outlines of infrastructures-in-use and from the circulation and disappearance of appliances and practices are complicated, fluid and exceptionally hard to define, but they are clearly not urban.

At first sight, this leaves us with something of a conundrum: urban infrastructures – those which are made in the city and by the city, and which define and enable city life - are *non-urban* when viewed as infrastructures-in-use. The way out is to realise that the contours of cities, infrastructures and social practices do not correspond. The next step is to develop methods of characterising and describing networks and forms of connection and circulation that link infrastructures and practices, that extend beyond the city but that also make cities what they are. In this chapter I hope to have made a first move in that direction.

Acknowledgements

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[1] Questions of consumption and anticipated use are important for designers and planners, and for methods of predicting and providing for future demand. However, techniques of anticipating and providing for future demand typically depend upon methods of aggregating, averaging and modelling generic trends for instance in traffic flow or energy consumption. The part that infrastructures themselves play in creating and sustaining the very practices on which demand depends is routinely overlooked.

[2]For example, Saint Gobain-PAM produces manhole covers that are exported around the world. http://www.pamcovers.com/

[3] For example, infrastructures can be seen as carriers of moral and political ideas; they often reproduce and embody forms of knowledge (both expert and lay), and they have various organising and 'disciplining' effects on those who interact with them.

[4] https://www.whatdotheyknow.com/request/traffic_volume_pre_and_post_hind and http://www.roadtraffic-technology.com/projects/a3hindhead/

[5] It was awarded the status of 'International tunnelling project of the year' in 2010. http://www.roadtraffic-technology.com/projects/a3hindhead/

[6] The UK's Electrical Contractors' Association currently recommends 37 double power sockets for a small home. http://www.eca.co.uk/search/?q=increasing%20power%20sockets&Module=FileLibrary

[7] Infrastructure projects generally have double lives: existing and being designed to work as vehicles of financial accumulation and profit *and* as roads, sewerage systems, power stations etc.