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From the Guest Editors

Splintering Urbanism at 20: Mapping Trajectories of Research on Urban Infrastructures

Introduction: Two Decades of Splintering Urbanism

Stephen Graham and Simon Marvin's *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition* (2001) brought the study of infrastructure to the core of urban studies and inspired the “infrastructural turn” in the social sciences more widely. The book catalyzed a rich trove of research on how technology and society are implicated in the production of contemporary cities. More than any other publication, it has animated the socio-technical systems of water, energy, transport, and telecommunications as fundamental to the functioning and livability of cities. It has inspired scholars to seek out the vital processes and politics of the cables, wires, pipes, and roads that undergird urban development. The twentieth anniversary of the book provides a good opportunity to reflect on the impacts of the book and to consider the emerging trajectories of scholarship on urban infrastructure.

Splintering Urbanism has taken on that rare quality in the history of urban thought and research in that it is both a text and an event. Of course, it is not the first book to focus on the relationship between the city and its infrastructure systems. It builds upon the work on large technical systems (Hughes, 1983; Mayntz and Hughes, 1988; Summerton, 1994), network urbanism and societies (Dupuy, 1991; Castells, 1996), socio-technical transformations (Winner, 1986; Bijker and Law, 1992), the role of infrastructure in histories of urban planning and government (Tarr and Dupuy, 1988; Aibar and Bijker, 1997), and research on the emergence of information and digital technologies in the city (including Graham and Marvin's first opus *Telecommunications and the City*, in 1996). Indeed, Graham and Marvin (2001: xxvi, xxv) begin *Splintering Urbanism* by acknowledging that “this book, more than most, has been possible only by drawing on and synthesizing a huge body of work” that informed their “fascination with the complex intersections of cities and networked technologies.”

The book was published amidst a rich stream of research already in train across urban and regional research in sociology, geography, and planning that centered on the production, politics and materialities of urban and regional infrastructure. This work examined infrastructure in and between cities, from the labor and significance of large infrastructural projects in the history of cities, regions, and nations, to the varied and highly uneven experience of access to and use of infrastructure services from water and sanitation, to electricity and transportation. *Splintering Urbanism*, however, triggered a significant perceptual shift by providing a means to read and apprehend the urban condition through infrastructure. Take, for instance, a fairly straightforward case of someone living in a peripheral neighborhood, with adequate public transport or a private car to utilize a freeway to access different locations, and someone else living nearby but blocked off by that freeway and lacking any viable transport

options. *Splintering Urbanism* provides a vocabulary not just for naming these phenomena but for situating them within an explanatory framework to understand and critique. This is the book's remarkable achievement: to produce a mode of apprehending through infrastructure.

The book places infrastructure at the heart of understanding the social and political composition of cities worldwide. Infrastructures, the authors powerfully argue, are not simply neutral carriers of things, flows, or resources; they are the trenchant mediators of political and economic power that reinforce existing social inequalities and produce new forms of disparity. A book of remarkably ambitious scope, *Splintering Urbanism* charts the failed attempts to create a "modern infrastructural ideal," particularly in Western Europe and North America, and demonstrates how the histories of network design, construction, and maintenance are simultaneously histories of both urban equality and cohesion and, increasingly, fragmentation and inequality.

The effect of *Splintering Urbanism* was catalytic. Its impact can be measured in crude citation terms (close to 6,000 Google Scholar citations as of March 2021), but of greater significance is its qualitative influence on how urbanists think, approach, problematize, and research the city, urbanism, and urbanization. And yet, the book is also about more than infrastructure, or, rather, it was about how infrastructure so often becomes enrolled in many related concerns. Graham and Marvin examine the "splintering" of public space and provisions, demonstrating how neoliberalism—and in particular the relations between privatization, liberalization, and the application of new technologies—shapes a globalizing process of "unbundling" infrastructure, outlines a theoretical approach to socio-technical urbanism, and establishes an agenda (or manifesto, as they called it) for a progressive networked urbanism. It connects the specificity of infrastructure transformation and urban inequality to evolving political economic shifts and the politics of public space, and thus defines an approach to thinking and researching cities materially and relationally. It grapples with the influence of racism, sexism, and ableism in the unequal production, experience, and politics of infrastructure, as well as the importance of context in shaping infrastructural urbanisms in different parts of the world. While these moments are sometimes brief or fleeting in the book, the text nonetheless offers a platform and point of departure from which others can push the field into new directions (Coutard, 2008).

The book had an immediate impact. It very quickly became part of the lexicon of writing and talking about infrastructures, cities, and inequalities in conferences and publications. It launched a set of vocabularies into the center of research and theorizing on the urban condition, including not just "splintering" but a wider grammar of fragmentation, from "unbundling," "premium networked spaces," and "enclaves," to "cherry-picking," "social dumping," "bypass," "tunnels," and the "infrastructural ideal." Today, it is a key text for graduate students who are studying the social, political, and cultural aspects of urban infrastructure, but is also a must-read book for all scholars interested in cities. In short, it is a foundational text in the wider project of critical urbanism that highlights the centrality of technology in shaping the urban condition. In this sense, *Splintering Urbanism* can be described not only as an intellectual *tour de force* but also as an important event in interpreting and understanding the materiality and politics of the processes of urban development.

Urban Infrastructure Studies: Present and Future Trajectories

Since the publication of *Splintering Urbanism*, there has been a veritable explosion of work on urban infrastructure. Of course, not all of this research takes the book as a central point of reference, but a remarkable number do and almost all have been influenced by it. If the

“infrastructural turn” in urban research, as Ash Amin (2014: 138) has described it, has repositioned infrastructure from a largely passive backdrop to a “lively” presence in the political, economic, cultural, and environmental reproduction and transformation of the city, then the book’s role in this has been firmly center stage.

What, then, can this collection of commentaries add to the urban infrastructure scholarship that was sparked by Graham and Marvin two decades ago? The purpose of the collection is not so much to revisit the book and the debates and critique around it, but instead to pursue two aims. The first is to think about the issues that the book introduced and how the questions it attended to have changed over time. The second is to take stock of the disparate field of urban infrastructure research and to speculate on where it might be heading in the coming years. The collection explores the multiple agendas that have driven urban infrastructure research in the past two decades, including rising preoccupations with pervasive digital technology, new ecological imperatives in an intensifying climate emergency, the persistence of socio-spatial and racialized inequalities, and the potential for more socially just and ecologically sound urbanism. In this section, we set out the key themes raised by the contributors.

Questioning Infrastructures

The commentaries clearly reflect and reveal shifting ideas about what infrastructure actually *is* and the sheer diversity of objects, components, processes, practices, and relations through which it is constituted. On the one hand, it would be fair to suggest that many of the contributions implicitly start from the imaginary of infrastructure as conceptualized in *Splintering Urbanism*. These essential urban systems and networks of water, waste, energy, transport, and communications are sunk and obdurate and increasingly subject to neoliberal transformation through which they have been politically, economically, and socially fragmented. On the other hand, as in much of the wider literature that has contributed to the “infrastructural turn” in the social sciences over the past two decades, Graham and Marvin’s notion of infrastructure is extended to new objects and services such as green infrastructure (Gabrys) and smart platforms (Odendaal). Infrastructure also becomes a conduit for an expanding palette of flows and exchanges including viruses (Keil), policies (Chang), and ecological resources (Coutard and Florentin). The conceptualization of infrastructure is expanded beyond the dominant linear production-consumption trajectories to be understood as situated entanglements of systems of provision and contingent daily practices and experiences (Guma, Monstadt, Simone), even if, as Furlong argues, there tends to be a bias toward supply and less focus on demand.

Infrastructure is most often understood as a *problématique* of the state and market, and here the figure of privatization and corporate power, so often the focus of *Splintering Urbanism*, is especially important as a key route through which infrastructure is understood to change, usually in ways that deepen inequalities, and become politicized (see Bakker, 2010). Castán Broto posits what a return to “big” infrastructure (perhaps on a similar scale to Graham and Marvin’s “modern infrastructural ideal”) might entail as significant state investment is mobilized through a prospective “green new deal” in Europe and the United States. Chang’s text makes the case for a focus on circulations of finance and investment, while McNeill identifies new value extraction from infrastructure-related finance instruments and mechanisms, mirroring the rise of financializations of infrastructure in the last two decades (see Torrance, 2008; Loftus and March, 2016) which renders infrastructure as a new asset class or debt-based market instrument to be bought and sold.

Some of the commentaries extend Graham and Marvin’s analysis of the social and economic development of urban infrastructure to its ecological dimensions, reflecting on the

increasingly central intersections between infrastructure and the climate crisis, resource distributions and wide-ranging environmental concerns (Castán Broto, Coutard and Florentin, Gabrys, Keil). Twenty years on, a vibrant field of research in and around urban political ecology, including some of Graham and Marvin's subsequent work, has done much to expand the analysis of infrastructure, the environment, and the production of inequalities (Heynen et al., 2006; Hodson and Marvin, 2009; Graham, 2015; Ernstson and Swyngedouw, 2019). As Castán Broto and Keil argue, that concern for ecologies of infrastructure and their uneven distribution is only likely to increase in an era of "climate society" or planetary urban infrastructure flows and exchanges in which infrastructure is at once a major part of the (environmental) problem and a possible response.

This environmental concern also overlaps with another ontological evolution in infrastructure, as new materialist thinking has found its way into urban studies, sparking an array of studies of materiality as a distinctive way to reconceptualize human-environment relations. The capacities of different infrastructural materials—pipes, wires, electrons, digital systems, improvised arrangements, and so on—influence the ways in which infrastructure becomes appropriated or enrolled, albeit unevenly, into all kinds of collectives, and research here has been vital in opening up new ways of thinking about these agentic materialities of urban life and politics (De Laet and Mol, 2000; Bennett, 2005; Farias and Bender, 2010; McFarlane, 2011; Amin, 2014; Lancione, 2014; Coutard and Rutherford, 2015; Wiig, 2016; Rutherford, 2019). Gabrys' exploration of the digitalizing and ordering of nature as it becomes "programmed to quicken to the logic of circuits, chips, and capital", and Odenaal's focus on the different components and protocols of platforms as infrastructure speak to this materialist perspective, as do Enright's infrastructural imaginings through which infrastructure actively makes visible and traceable all kinds of urban movements and social processes. Meanwhile, Coutard and Florentin call for more attention to the stocks and flows of ecological resources that move through and over infrastructure rather than the physical qualities of infrastructure per se. This suggests the need for more in-depth studies of urban metabolic circulation to bridge territorial and political ecology perspectives and to highlight the politics of resource management and use amid the uneven movement and accretion of energy and fluids.

These ontological interpretations frame infrastructure as inherently processual and relational (Graham and Marvin, 2001), always becoming and in the making, rather than assuming an *a priori* and static artifact. This goes beyond asking "what is infrastructure?" to focusing on "what does infrastructure do?" or perhaps better, arrives at a sense of what infrastructure is through a focus on its differential and uneven enactments. The present continuous verb "infrastructuring" used by Simone, for example, captures the sense of socio-technical configurations being in a constant state of contingent reproduction, continuously open to interpretive flexibility through contestation, situating, and positioning.

Knowing Infrastructures

Inevitably, if infrastructure itself is always changing, then how we come to know and study infrastructure in critical urban research is also constantly evolving. Taken as a whole, the commentaries reflect some of the wider tendencies to push towards ever new methodological approaches, concepts, and theories of urban infrastructure, and to go beyond the liminality of components and systems to render visible infrastructure's crucial workings and consequences.

There have been many salutary recent efforts to push and rethink the conceptual coordinates of infrastructure. This includes work on topology (Harvey, 2012), ambience (Larkin,

2013), infrastructure as force (Amin and Thrift, 2017), cyborg urbanization (Gandy, 2005), metabolic transformation (Luke, 2003; Swynedouw, 2004; Karvonen, 2011; Loftus, 2012; McFarlane et al., 2014; Keil, 2020), urban operating systems (Luque-Ayala and Marvin, 2020), and the entangled life of improvisatory and incremental infrastructure in forms of urban inhabitation and politics (Simone, 2004, 2014, 2018; Chattopadhyay, 2012; Silver 2014).

Inspired by this and other work, the contributors here seek out vocabulary and epistemologies to capture and meaningfully unpack the flux and change that we can observe both on the ground in infrastructure practice and in our conceptual interpretations of the current urban infrastructural moment. Enright mobilizes imaginaries for “thinking about the material conditions of knowledge, power, and sight and how these are generated, practiced, and transformed.” Addie and Monstadt both reflect on the emerging concern for urban temporalities and rhythms as applied to urban infrastructures with respect to differential experiences of regularity, speed, and periodization of connection and access. Guma, relatedly, is concerned with provoking more consideration of the “incompleteness” of infrastructure in African cities in particular. Salamanca and Silver’s text proffers a generative notion of “excess” for thinking about “what leaks in processes of splintering urbanism,” the exclusions and evacuations of infrastructures of extraction and circulation. They draw attention to the methodological role of infrastructure as “archive,” “making visible and analyzable modernity’s ‘off-frame’ lives in racialized political economies.”

The repositorial role of infrastructure, as a palimpsest and a steady build-up of layers and accretions of components, systems, and their social and political significance over time can be used to “read” and interpret stories of urban socio-technical change (Monstadt, Moss). Part of the contradictory nature of infrastructure, highlighted influentially by Star (1999) and several contributors here, is that its constant flux and change (in shifting political economies) goes hand in hand with a stable, sedimentary, situated quality that demands close empirical scrutiny. Creative engagements with the enablements and constraints of infrastructure have also multiplied in recent times as visual art, film, and (science) fiction have become imaginative terrains for re-viewing and rethinking urban socio-technical worlds.¹

Another important trend in infrastructure studies that both pre-dates and is inspired by *Splintering Urbanism* is the increasing number of ethnographies that emphasize the diverse lived experience of infrastructure and the multiple ways in which heterogeneous systems interweave with habits, doings and cultures, “unsettling” bodies and their arrangements (Simone). This is testament to how our collective understanding and knowledge of the relations between infrastructure, cities, and the political has developed and grown more nuanced in the past two decades (Björkman, 2015; Anand, 2017; Fredericks, 2018). The short commentaries here preclude detailed empirical reflection but Ranganathan, Saguin and Alvarez, and Salamanca and Silver hint at their in-depth, long-term insights on Bangalore, Manila, Palestine, and Cape Town, respectively. These infrastructure ethnographies have also been conducted in the Global North, none richer in its powerful historical tapestry of political infrastructure entanglements than Moss’s (2020) work on Berlin that inspires his commentary in this collection.

Politicizing Infrastructures

All of the commentaries in this collection offer pertinent and punchy reflections on infrastructure politics as well as the production and reinforcement of socio-spatial inequalities. This is already apparent in the ontological and epistemological reworkings of infrastructure as described in the previous paragraphs. However, given the absolute centrality of critically understanding the political contexts, modalities, and implications of urban infrastructure

to *Splintering Urbanism*, it is worth outlining specifically what the commentaries propose in terms of political analysis and possibilities, or what Enright evocatively describes as “ways of attending to the topological assemblages, the frictions and flows, and the nightmares and reveries that constitute infrastructure’s contemporary manifestations.”

Over the last two decades, a disparate, wide-ranging body of research has demonstrated the connections between infrastructure, inequality, and the political across a variety of fields. This includes work on the pivotal role of infrastructure for basic provisioning such as water, sanitation, and energy, in shaping urban ecologies and the urban implications of climate change, in issues of privatization and ownership, in the digitalization and automation of collective provision, and in the targeting, removal, and demolition of infrastructure in urban militarization, securitization, and warfare (Gandy, 2003, 2014; Coward, 2008; Graham, 2010; Kitchin and Dodge, 2011; Castán Broto and Bulkeley, 2013; Cowen, 2014; Easterling, 2014; Graham and McFarlane, 2014; Ranganathan, 2015, 2018; Rutherford and Jaglin, 2015; Gabrys, 2016; Marvin et al, 2016; Wiig, 2018; Wiig and Wylly, 2016; Karvonen and Guy, 2018; Gopakumar, 2020; Karvonen, 2020).² The commentaries here all note the heuristic power and salience of *Splintering Urbanism* for thinking about and productively analyzing the fundamental politics of urban infrastructure—and indeed the political intervention that *Splintering Urbanism* constituted itself in drawing attention to the production and reinforcement of social inequalities through infrastructure, and thus in beginning to sketch out, notably in the postscript of the book, a set of areas and questions not just for further study but also for critical engagement and action. The contributors here offer diverse takes on infrastructure, inequality, and the urban political.

Some of the texts study political *contexts* that were less-present in *Splintering Urbanism* or less-apparent when the book was published. Ranganathan extends the analysis of infrastructure inequalities to the specific concerns around caste segregation, impurity, and untouchability that exacerbate the splintered condition of Indian cities. Salamanca and Silver’s reflections place racial capitalism and settler colonialism at the heart of evolving political economies of infrastructure. Both of these contributions point towards wider concern with Graham and Marvin’s relative blind spot on cities of the Global South. The more recent emphasis on colonial legacies and fragmented, segregated urbanism enriches infrastructure studies with contextual dynamics that go beyond neoliberal political economies. Indeed, Ranganathan, Simone, and Salamanca and Silver’s commentaries, for example, substantively elaborate on what paying attention to context might mean intellectually and politically. Graham and Marvin’s splintering meta-narrative clearly brought the politics of infrastructure to the fore in a particular way.

These contributors, like many of the recent ethnographies of urban infrastructure mentioned above, push at the political question from another angle, namely the grounded nature of infrastructure’s affordances and potentials. Here, the question of “knowing” infrastructure explored above is closely related to how the political is written, because context — social, material, economic, and environmental relations in place and historically shaped through all kinds of processes—provides a ground for seeing and conceptualizing that is less amenable to the meta-narrative form. This can disclose quite distinctive insights and terrains for political thinking and intervention through the urban fabric.

Other commentaries elaborate on the varying *modalities* through which infrastructure becomes or is made political. Saguin and Alvarez focus on how concrete redevelopment projects and fuzzy resilience objectives can be mobilized to push less-desirable populations out of the city to unserved peripheral areas. Addie shows how “infrastructure time” can be put to work for differing political rationales, and here attending to different kinds of rhythms and temporalities can reveal a changing and multi-faceted political realm. Furlong observes

how the inherently contradictory “both-and” nature of infrastructure necessarily leads to particular choices and decisions that constitute attempts at resolution but often according to the interests of those in charge. This neatly captures a prevailing argument across infrastructure research: that infrastructure often does not comply with our political and conceptual categories, that it can be both extractive and welfarist, simultaneously vital to urban life and a threat to it, and so on.

Finally, most of the commentaries reflect on the actual or potential political *outcomes* of the infrastructure entry points and configurations. It is striking that many of the authors highlight the persistence of infrastructure inequalities and the emergence of new forms and locations of splintering. Both Keil and Sheller describe powerfully how the viral circulation of COVID-19 through networked infrastructures is amplifying the existing inequalities and injustices of public health in many cities around the world. Castán Broto captures an emerging world of climate inequalities which will require practical mobilization of existing understandings of diverse, hybridized infrastructures (see Jaglin, 2014; Lawhon et al., 2018) to move beyond dualistic and opposing logics of centralized versus decentralized systems. If these analyses of the current urban condition are anything to go by, then processes and practices of splintering urbanism are alive and well, suggesting that Graham and Marvin’s pathbreaking framework will continue to be relevant for the foreseeable future.

On a hopeful note, many if not all of the commentaries also reflect on the possibilities for more progressive infrastructure configurations whether in terms of contestation and resistance of dominant logics and developments on the ground or the development of alternative urban infrastructure networks. This builds upon Graham and Marvin’s normative agenda to open up infrastructural logics to interventions that can improve the lives of urban residents in fundamental ways. It is here where *Splintering Urbanism* injects optimism and hope for more progressive and just modes of urban development (Coutard and Guy, 2007).

Concluding Reflections

Reflecting on the flourishing expansion of urban infrastructure research since Graham and Marvin positioned networked infrastructure systems as the “Cinderella” of urban studies, Moss wittily recasts infrastructure now as the fairy godmother “permeating narratives of the city with unexpected, insightful, and sometimes game-changing interventions.” It is no exaggeration to suggest that more than any other publication, *Splintering Urbanism* is responsible for this “rags to riches” transformation. Urban studies today, and accounts of the city more generally, have been enriched by the book’s critical, socio-technical, comparative and multidisciplinary analysis in a way that very few publications manage to achieve. On an individual level, each of us, and we suspect each of the contributors to this special issue, might well be doing very different things or at least studying cities in a quite different way if we had not encountered *Splintering Urbanism*. Our hope is that we can continue to use the book to inspire future urbanists to interrogate the multiple implications of urban infrastructure development and change.

We end this introduction to the special issue by encouraging readers to dive into the commentaries and engage with the stimulating, pertinent perspectives on the intellectual, analytical, and practical legacy and continuing relevance of *Splintering Urbanism* that we have touched upon briefly here. The issues described by the contributors around ecologies and temporalities of infrastructure and emerging zones of marginalization will require further research in the coming years. Like the open, uncertain, and multiple possible urban infrastructure futures that the contributors here envisage, Moss observes how future histories of urban infrastructure will have to be cognizant of the messy, deviant qualities and pathways

that the city fosters as a complex, contested socio-technical process and artifact. From our perspective, this captures quite nicely the achievements of *Splintering Urbanism* in making sense of urban socio-technical complexity, both now and in the coming years.

Notes

1. For example, see the one-hundredth issue of the journal *Flux* (<https://www.flux100.cnrs.fr/>).
2. For reviews, see McFarlane and Rutherford, 2008; Coutard, 2008; Monstadt, 2009; Furlong, 2011; Larkin, 2013; Amin, 2014; Rutherford, 2019.

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