

Roadsides

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Urban Bioinfrastructures

Lorem ipsum

Edited by: Raúl Acosta and Lukas Ley

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Urban Bioinfrastructures: An Introduction

Raúl Acosta and Lukas Ley

Cities rely on numerous infrastructures to support life: pipes, cables, antennas, roads and other technologies facilitate the distribution and use of water, energy, information and people. Current theories of urban flows undergirded by infrastructural systems, however, often focus on the perseverance of human life at the expense of other lifeforms. But does this conceptualization of life limit our understanding of the true liveliness of urban infrastructure? The contributions to this themed collection interrogate urban infrastructure as sociobiological configurations that not only sustain life in the city but in turn are constituted, patterned and modified by it.

Electricity lines that form an urban arboreality for macaques. Canals that double as biotopes. Gardens that turn into wetlands. These distinctly urban phenomena attest to the manifold and often unexpected appropriations of city infrastructure created by (and for) humans. They raise urgent questions about multispecies design, ownership and stewardship of infrastructure, as well as of what qualifies as ‘environmentally friendly’ town planning. Such phenomena also indicate that multiple metabolisms intersect in the city, and reach beyond it. Infrastructure is never just a single entity or one discrete thing but rather an evolving set of multispecies and material relations. As Maan Barua states, the “more-than-human enfleshments and enmeshments with infrastructure, where corporeality and substrate meld or the habitat and habits of living beings become synonymous with infrastructural environments, point to a wider infrastructural ontology” (2021: 1467). With him, we contend that this wider ontology is necessarily lively, and is directly related to a dynamic temporality whose rhythms do not necessarily align with those of humans (Barua 2023). In fact, one could argue that most of the predicaments that urban planning confronts in the Anthropocene derive from a historical underappreciation and misconception of other-than-human patterns (see [Roadsides Collection no. 008](#)).

Residents of the subdistrict Kemijen removing water hyacinth, a prolific weed of waterways, from the Banger River, a drainage and sewage canal in North Semarang, Indonesia.

Photo: Puji Sarwono, 2023.



While exploring the multiplicity and liveliness of urban infrastructures, this collection also responds to debates surrounding the use of ‘green’ and ‘blue’ infrastructures – plant- and water-based infrastructural systems – to help reduce environmental risks such as flooding, drought or heat. These attempts emerge from criticism of the carbon footprint of conventional infrastructures; in response, they favour involving nature in urban design. Delegating infrastructural work to animals, plants, fungi or indeed entire ecosystems raises interesting questions, as such projects attempt to turn nature into infrastructure (Wakefield 2020). For instance, how can we assume that nature will work as we intend it to? What are the philosophical and economic premises of designs that delegate work to non-human others? In our view, though, both nature-based infrastructures and conventional designs fail to consider the complex interplay of ecology, technology, labour and materials at the core of urban worlds. Both ignore the fact that infrastructures regularly refuse to work as planned and/or get repurposed by other processes. As we remain sceptical regarding the green and blue turns in infrastructural provision, the articles in this collection suggest that the increasing popularity and perceived need for such infrastructures reveal much about the current moment of urbanization. There is clearly a desired return to liveliness in the

face of the “death of nature” (Rademacher and Sivaramakrishnan 2021: 1). Introducing the term ‘urban bioinfrastructures’ responds to that desire, while also interrogating the ambivalent politics of this turn to nature.

Bioinfrastructures raise important questions about the meanings of life and its unequal distribution through infrastructure. In the remainder of this introduction, we elaborate our notion of life and bios – differentiating both from the liveliness envisioned by nature-based solutions. Our view is that neither life nor bios are politically innocent concepts. The notion of life as opposed to nonlife was proposed by the natural sciences, but even scientists have come to agree that this division gets “in the way of understanding the force and formation of existence” (Povinelli 2016, 2019). Instead of simply assuming that something is alive, this collection explores how it becomes a figure of life in historically specific contexts, to the extent in which existence always elicits questions about value and morality. Exploring existence at the nexus between organic, material and political transformations, we follow new materialist scholars who embrace the vibrancy of non-organic matter – such as stone or plastic – without romanticizing a presupposed liveliness of such substances. We rather posit that existence unfolds in encounters with this stuff. When this existence becomes the subject of political or technical reasoning (Rose 2007), it may be configured as bios. Bios falls squarely in the realm of politics.

Michel Foucault coined the term biopolitics to capture the “attempt, starting from the eighteenth century, to rationalize the problems posed to governmental practice by phenomena characteristic of a set of living beings forming a population: health, hygiene, birthrate, life expectancy, race” (2008: 317). As we know, modern state bureaucracies seek to extend their control into the capillaries of society so as to sustain specific biological functions of life, human or otherwise, while suppressing and eradicating others. During colonialism, the suppression of undesirable lifeforms (viruses, bacteria, animals) went hand in hand with the extinction of Indigenous culture and human–environment relations in the colonies. For example, colonial city-building destroyed coastal wetlands (Scaramelli 2021) in order to facilitate ‘modern’ water management and prevent the spread of malaria into the new European quarters, as was the case in Indonesia (Ley 2021). Bioinfrastructures, in our view, can embody biopolitical projects. In absorbing and channeling various material and organic logics, they can, however, also “undercut” them (Bremner 2020).

In cities, many lively urban environments are enjoying a comeback. Wetlands, for instance, are not only recognized for their many indispensable ecosystem services and as carbon sinks, but also for their hosting of multiple species which escape utilitarian principles. This multiplicity of life is therefore recognized as intrinsically beneficial and leads to the displacement of other forms of existence (see Scaramelli 2021). In *The Probiotic Planet*, Jamie Lorimer (2020) argues that after having lived through an anti-biotic age, humanity is now considering the pro-biotic path. This route entails using other lifeforms to help ecosystems recuperate after decades if not centuries of human predation. “The probiotic interest in rewilding is part of a wider rethinking of the management of biophysical systems, including forms of natural flood management and coastal realignment, localized methods for weather modification, and nature-based, planetary-scale schemes for geoengineering through afforestation, ocean

seeding, or solar radiation management” (Lorimer 2020: 2). Today, cities are no longer considered as separated from nature, but rather as peculiar configurations of natural order themselves (Gandy 2022).

Another concern is to distinguish ecology from bios to explain our preference for the prefix bio- over the qualifier ‘ecological’. We recognize in ecology a set of lively processes that emerges as a flexible pattern of connections. A forest, however, is not necessarily ecological, as Elkin (2022) puts forward based on her critique of afforestation. To Elkin (2022: 8), plantation techniques are actually “political and distressingly social.” Yet while forests are not always ecological, they are lively – they grow, proliferate, infringe on other spaces, and provide niches for many organisms, such as fungi.

The recent emergence of bioinfrastructures remains under-theorized. With this collection of *Roadsides*, we start a conversation across academic disciplines that we hope will gain traction. We want to engage critically with the surging interest in blue and green infrastructures, as we believe they may offer a path to undermine some of the anthropocentric tenets of modernity. By paying attention to cities as botanical (Gandy and Jasper 2020), and their infrastructures as necessarily alive (Hetherington and Campbell 2015; Hetherington 2018; Krieg, Barua and Fischer 2020), a radically different type of urbanism starts to take shape. This is not simply about particular vital configurations of agentic members in infrastructures (Durham, Ferme and Costa 2019), or about facilitating novel ways of distributing water (Radonic 2018). It is rather a whole reconsideration of urban metabolic processes, which could have far-reaching implications.

For these reasons, we believe that the role of the imagination is crucial. We thus consider it useful to remember that humanity has produced other forms of city life. From a *longue durée* perspective, lessons from historical ecology (Balée 2012) provide examples of forgotten urban experiments. In what is now the Brazilian Amazon, for instance, researchers have uncovered evidence of ancient ‘garden cities,’ so called because they resembled those considered a future ideal by Ebenezer Howard at the beginning of the twentieth century (Howard 1902; Heckenberger et al. 2008; Mann 2008). Looking at other cases of controversial urban development promises opportunities for rethinking not only the role of bioinfrastructures but also their significance for larger political projects, emancipatory movements and Indigenous sovereignty (Newitz 2021).

We are grateful to all the authors in this collection for engaging with this idea and for enriching our vocabulary and imaginary.

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Lukas Ley is an environmental and urban anthropologist working at the Max Planck Institute for Social Anthropology in Halle, Germany, where he leads a DFG-funded Emmy Noether research group on the infrastructural lives of sand in the Indian Ocean world. His research is broadly concerned with marginalization, temporality and the material environment within urban landscapes. Current research projects investigate the role of sand in building urban commons and dispossession in Denpasar, Indonesia, and the future of concrete in Marseille, France. Ley's first book, *Building on Borrowed Time: Rising Seas and Failing Infrastructure in Semarang* (University of Minnesota Press, 2021), was awarded the Social Science Prize by European Association for Southeast Asian Studies and received an Honorable Mention for the Harry J. Benda Prize of the Association for Asian Studies.

Gradients of Wetness:

Gardens as Experiments Towards Wetness

Andrea Aragone, Catalina Codruta Dobre
and Giuseppe Faldi

Towards Wetness

In many European and North American cities, drainage and sanitation infrastructure is a complex network that runs underground and along roads, collecting both wastewater and rainwater from buildings and open spaces, before finally discharging it after treatment into surface water (Secchi 2011). Drainage infrastructure is based around a paradigm of dryness, which consists in keeping space dry by channelizing and discharging rainwater as quickly as possible. Such infrastructure often malfunctions: floods, leaks and overflows are only a few of the recurrent problems. These issues can highlight the obsolescence of drainage infrastructure that is no longer able to cope with increased runoff from growing urbanization or changing precipitation patterns (Karvonen 2011), and reveal the necessity of acting immediately to remedy the situation (Tjallingii 2012;

Gandy 2014). Furthermore, hydrological dysfunction affects the process of urbanization itself, requiring us to reframe cities as emergent ecosystems where multiple species and environmental dynamics overlap (Alberti et al. 2003; Gandy 2022). More particularly, as people's gardens cover large portions of the urban environment, they have a crucial role to play as spaces where novel combinations of drainage infrastructure can emerge.

An opportunity for the transformation of current drainage practices, referred to in this paper as 'wet transition', arises from the ongoing paradigm shift in urban planning and design from dryness to wetness. Shifting towards wetness suggests considering the hydrological cycle differently. If dryness centres on surface water and the flow of discharge, wetness grasps the fact that rain is where all flows of water start and that runoff should be the main focus (Da Cunha 2018).¹ Precipitation, floods, evaporation, evapotranspiration and infiltration of rainwater are basic wet processes; thus, the atmosphere, vegetation and the ground are all components of wet infrastructure. At its core, this wet infrastructure is decentralized – small scale, spatially distributed, fit-for-purpose and embedded in the urban environment (Yu et al. 2011) – and combines both technological (often low-tech) and natural elements. The backbone of wet infrastructure is the rainwater, which falls on every roof and reaches every garden (Tjallingii 2012).

¹ Runoff is "the flow of water from the land as both surface and subsurface discharge," or in the more restricted use, "surface discharge in the form of overland flow and channel flow" (Marsh 2010: 493).

Residential Gardens as Wet Experiments

In many European and North American urban environments, large areas are occupied by open spaces, mostly residential gardens (Cameron et al. 2012; Jakobsson and Dewaelheyns 2018). In the frame of the experimental transdisciplinary project Brussel Water Sensitive City (Brusseau Bis), gardens become spaces for potential citizen wet stewardship (Nassauer 2011), based on different socio-ecological arrangements in which people's livelihoods can coexist with watery spaces, revealing their potential as key components of a decentralized drainage infrastructure. Our research tests and analyses innovative wet practices in individual and collective gardens to explore coalitions of private and public-private actors' ability to support the wet transition in the Brussels-Capital Region.

Residential parcels (left) and open-air spaces (right) within the Brussels-Capital Region.
Graphics: Andrea Aragone/Urbis, 2022.

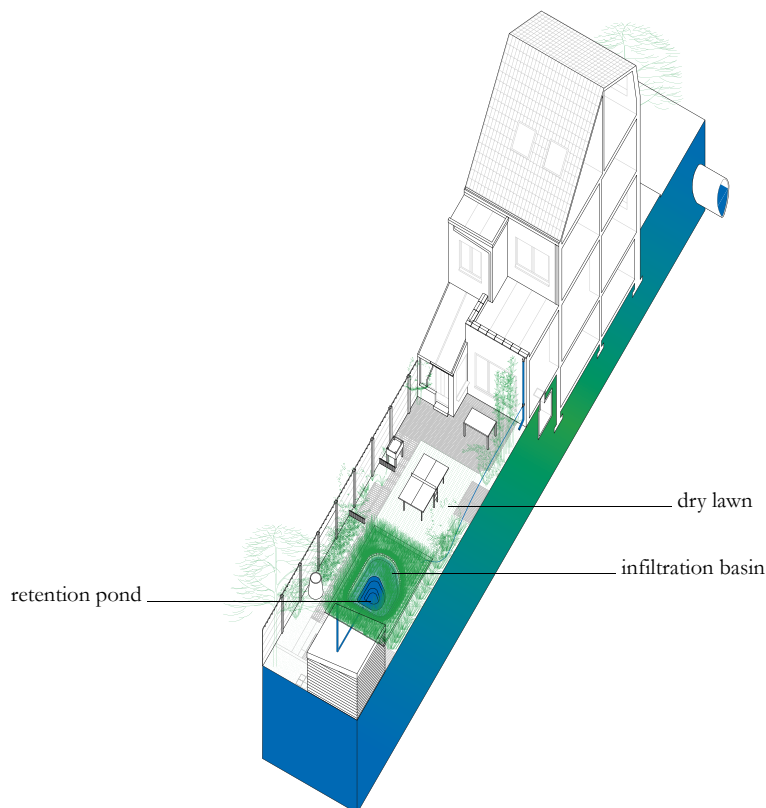


At present, 43 percent of the city is covered by residential parcels;² of which 62 percent is open-air surfaces such as asphalted driveways, decking and vegetated and concrete pathways, as well as lawns, flowerbeds and patches of trees. In addition to their typological diversity, residential gardens evince huge cultural and environmental potential (Egerer et al. 2018), being spaces in which human and other-than-human practices overlap. They are places of everyday life marked by the in-between experience (Foucault 1986), thus being at the membrane between human and wet practices. Gardens accommodate food production and horticultural practices, as well as hosting vegetation, insects and other wildlife and soaking up rainwater (Egerer et al. 2018). They comprise a major part of the urban ecosystem (Kowarik 2011; Cameron et al. 2012), even though they remain largely understudied and have unexpressed potential (Chalmin-Pui et al. 2019).

² Calculated by identifying parcels (source: Urbis) that are within residential zones defined by the Plan Régional d'Affectation du Sol. Residential parcels can be privately or publicly owned plots (e.g. social housing).

A Wet Domestic Garden and its Reverberations

In order to explore the wet potential of residential gardens, we tested wetness by carrying out experiments in individual domestic gardens and collective gardens in social housing blocks. The two residential garden types present different features in terms of ownership and management. Individual domestic gardens are private spaces managed by single households, while collective gardens in social housing blocks are public spaces managed by residents in agreement with a private management company. Here we focus on the example of an individual domestic garden in Jette, in the northern part of the Brussels-Capital Region.



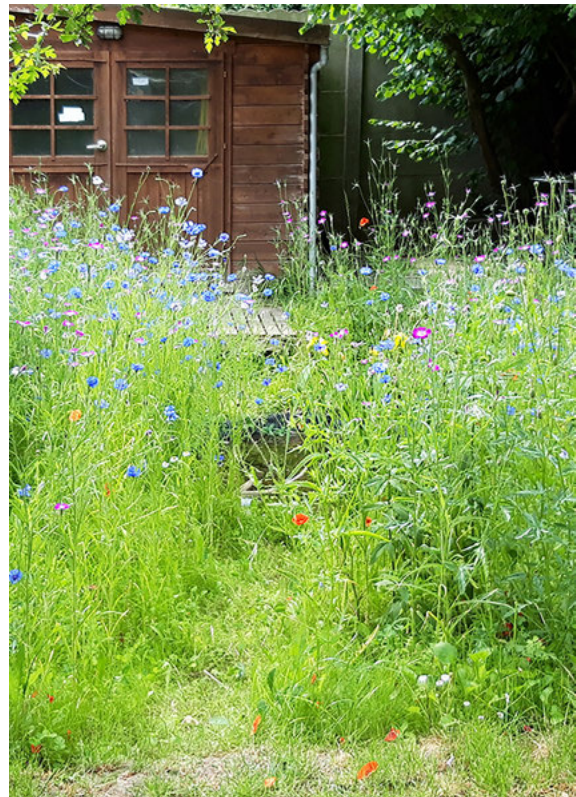
The design for new wet infrastructure in Sebastian's garden.
Image: Andrea Aragone, 2022.

This particular wet experiment was supported by a co-design process, based on two group workshops. Sebastian – the householder – together with some of his neighbours and one representative of the municipality attended the two workshops with us. Various possible design options were discussed, sharing the knowledge of each participant in order to define a collective wet project to transform Sebastian's garden. The project places rainwater and its flows at the centre of the design as well as framing wet and human practices hosted in the garden. The result is an infiltration basin that expresses the potential of vegetation and the ground to absorb rain redirected from the roof; a small retention pond in the middle provides a waterbody for insects and birds, while the lawn gives Sebastian and his son a space to play ping-pong and relax.³ These design decisions were implemented during a collective construction process as a multiplicity of actors engaged physically to put in place the group choices. The wet experiment in Sebastian's garden has already had reverberations in the neighbourhood and beyond. It is attracting the attention of other inhabitants, inspiring them to transform their own gardens and become part of the decentralized infrastructure.

³ The new wet infrastructure in the garden is entirely financed by the project Brusseau Bis.

A moment during the collective construction site (left) and the wet infrastructure enabled in the inhabitant's domestic garden (right).

Photos: Andrea Aragone (left), Sébastien (right), 2022.



Wet Experiments Nurturing Creative Design and Encouraging Stewardship

Some preliminary findings can be drawn from our ongoing experimentation. Firstly, such experiments have twofold potential related to wet design and wet stewardship. The re-landscaping of the domestic garden illustrates the development of decentralized infrastructure in private spaces based on the paradigm of wetness, becoming itself an exemplary design for innovative and sustainable solutions. At the same time, the

collective nature of the experiment strengthens the network of participants, who consequentially become new stewards of wetness. This stewardship bridges the gap between individual action and common benefits by creating the conditions to further replicate and maintain wet experiments. This is in line with Ostrom's (2010) research on common-pool resources in relation to the need for climate action, which indicates that, different from large-scale units, households are potentially more apt to take positive action if they are well informed on the subject. Moreover, households form stronger reciprocal trust by working together locally to engage neighbours in climate action. Secondly, the experiment also reveals that for decentralized infrastructure to function it requires a polycentric system in the sense proposed by Ostrom (2010: 552) that is "characterized by multiple governing authorities at differing scales rather than a monocentric unit," where households acquire knowledge, and support the replicability and the future maintenance of the wet infrastructure. Finally, the wet experiment suggests moving from centralized water management to a shared decentralized system, which includes a large number of players and is based on the relationships between human and moisture dynamics. This reinforces current research on the role of voluntary citizen engagement that can lead to positive changes and is recognized as a necessity for the successful integration of urban rainwater at different scales (Dobre et al. 2018; Mees et al. 2018).

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Material Engagements with Fog in Lima

Chakad Ojani

In the Peruvian capital of Lima, local NGOs, conservationists and residents on the urban periphery try to harness ground-touching clouds as part of alternative water-supply systems and environmental infrastructures of underground water production. While NGOs set up fog-capture nets to respond to the absence of state infrastructure, conservationists adopt similar methods to repair damaged more-than-human relations and forestall desertification. Amid these attempts to bring about new environmental-infrastructural relations, the fog-catchers have re-attuned residents to previously backgrounded features of the city and the atmospheric: whereas the sky now abounds with water in atmospheric suspension, urban asymmetries are rendered conspicuous through the foregrounding of airborne pollutants. These occasions of “mutual” or “reciprocal capture” (Stengers 2010: 36; Choy 2018: 71) encourage a redescription of infrastructures as always and already bio.



Scholarly inversions have shown that infrastructures are the conditions of possibility for (certain forms of) life while at the same time being held together by a plethora of more-than-human relations (Carse 2012; Morita 2017; Barua 2021; Ojani 2023a). This means that infrastructures are reciprocal in their very nature: they are prone to modification by the processes and entities they animate and enfold – a point that is productively laid bare by attempts to infrastructuralize (Ballesterio 2019) ground-touching clouds in Lima. Here, an evasive and transitory atmospheric phenomenon is granted leeway to reconfigure residents' relations to their socio-environmental surrounds, sometimes with significant consequences for how they understand and situate themselves vis-à-vis the broader urban landscape. Taking its cue from this issue's introductory framing of infrastructures as biosocial, this article contends that it is through the recognition of the inevitable mutuality of capture that the bio of urban infrastructures might be given due relevance. The article speaks to recent scholarship on the experimental qualities of Latin American infrastructures more broadly (Alderman and Goodwin 2022), albeit in the context of non-governmental and small-scale interventions that, while difficult to sustain, have proved remarkably generative with respect to their speculative ramifications.

Morning fog blanketing the city.

Photo: Chakad Ojani, Winter 2019.

Infrastructuralizing Ground-touching Clouds

In the informal and recently formalized neighborhoods on the hilly peripheries of Lima, lack of state infrastructure is widespread – not least water and sewage. In 2019, around 1.5 million inhabitants remained disconnected from the city's water infrastructure grid. Once squatters obtain rights to reside on state territory, they are also entitled to demand various forms of infrastructural connectivity, but it can take decades for reservoirs and other infrastructures to arrive. Water-delivery trucks try to fill this gap. However, this water is expensive, not always safe to consume, and it is often unclear where it is actually coming from (see Ioris 2015).



Improvised housing in Villa María del Triunfo, southern Lima.
Photo: Chakad Ojani, Winter 2018.

In this context, ground-touching clouds have emerged as an alternative water source, initially among scientists who set up fog-catchers to study fog-plant relations along the Peruvian coast (Ojani 2022), and more recently among civil society organizations who adopt similar methods to provide alternative micro-infrastructure to residents on the Limeñan periphery. In brief, fog-catchers consist of large plastic nets situated perpendicular to the direction of incoming coastal winds. Lima is built on a desert with very little rain, yet coastal fog is ubiquitous, especially during the winter. These low-lying clouds consist of tiny water droplets too small to precipitate but which are easily entrapped in the nets. As they grow larger, the droplets trickle down and are led into a plastic water cylinder for later distribution, first through a gutter and then usually a larger pipe.



The water collected by the fog-catchers is contaminated with heavy metals and mostly used for irrigation; filtering it exceeds residents' financial capacity and lies well beyond the scope of what local NGOs can deliver. Besides, the meshes must be taken down each summer to be protected from the sun, and they require continuous cleaning and maintenance work as they tend to capture sand and dust. But the challenges extend beyond the recalcitrance of aerosols and the materiality of fog-catchers. Often, the apparatus is assembled by or for residents lacking formal permits to occupy state-owned land and is therefore at risk of removal or destruction by the authorities. As a result of these various obstacles, the fog-catchers repeatedly fail to live up to their promise as an alternative water-supply system and are eventually left uncared for. Even so, in some cases they have turned into technics of mediation for reading and sensing the city in a new key.

Installation of fog-catchers in Lima.
Photo: Chakad Ojani,
Winter 2018.

For example, in the Villa María del Triunfo district of southern Lima, an NGO-led fog-capture project not only brought to residents' attention the quality of the air they are breathing, but also helped articulate understandings of their urban condition in terms of state absence (Ojani 2023b). By gathering airborne pollutants on the surface of the rapidly blackened nets, the fog-catchers rescaled the atmosphere and, in doing so, threw into relief the broader socio-economic geometries of the city as well as the residents' place within it. As it happens, local researchers are now deploying fog-catchers as "[a]pparatuses of atmospheric attunement" (Choy 2018: 61) for turning the city's unequally distributed air qualities into a matter of public concern.



Blackened fog-capture nets.

Photo: Chakad Ojani,
Winter 2018.

While gradually falling out of use, another fog-capture project in the same district also explicated (Sloterdijk 2009) or rendered explicit an atmosphere abounding with water. In combination with the residents' observations of drying-out springs and the historical clearance of trees, the surprising volumes of airborne water collected by the fog-catchers prompted conceptualizations of the hills as an environmental infrastructure with the capacity to produce groundwater and even rivers, thus also spurring a reassessment of Lima's ecological history: the city is no longer perceived by the residents in question as necessarily arid but rather as subject to desertification. Following this newfound understanding of the hills as a bioinfrastructure whose capacity to accommodate ground-touching clouds had gradually degraded, the residents formed a local conservation association that sought to remedy the problem through the reforestation of what conservationists had come to call "natural fog-catchers" (Ojani 2023a: 27). Trees, they speculated, would restore the hills as ecologies of fog capture and, with time, help reactivate the districts' many ebbing springs – an endeavor that proved difficult due to unabating land occupations by squatters and what the conservationists described to me as organized networks of land traffickers, which further highlights how the urban precarity occasioned by Lima's neoliberal politics of housing also results in ecosystem devastation.

As an evanescent presence there one moment and gone the next, fog presents significant challenges to infrastructuralization. Whenever a momentary grip on the atmosphere is achieved, these low-lying clouds are not easily disjointed from their atmospheric background, instead turning the nets into indices of deep-seated asymmetries that condition residents' experiences of life on the urban periphery. Hence, attempts to establish relations of capture to fog reciprocally feed back into and modify actors' relations to the city. In some cases, this has amounted to a re-apprehension of Lima's hilly peripheries as aquatic landscapes in need of care and repair.



Bioinfrastructures Beyond Control

Understandings of infrastructures as socio-material assemblages that facilitate various kinds of flow are now widespread in the social sciences (Larkin 2013). Yet, as a means to mediate human and nonhuman agency, infrastructures are also subject to transformation by the unruliness of energies and their resistance to being captured and re-channeled, often with profound consequences for more-than-human relationality and the political (Jensen and Morita 2017).

While infrastructural capture and circulation rely on a “paradoxical generativity through constraint” (Degani, Chalfin and Cross 2020: 4), such enclosures also produce inevitable leaks, unexpected openings, and other, often unanticipated lines of flight (Ojani 2021; Simone 2022). For instance, energy capture “always generates some excess or surplus that may spin off into new directions” (Degani, Chalfin and Cross 2020: 4). The material properties of the substances to be infrastructuralized play a central role in the manner in which this unfolds. Timothy Mitchell (2011) describes how infrastructures of extraction and transportation of carbon and oil, respectively, produce different possibilities for agency and resistance among workers who ensure their smooth circulation. Transport by train or pipes requires distinct socio-material arrangements and these, in turn, enable and foreclose workers’ influence on the flow of goods in critical ways. Akin to how fog capture entails processes of mutual capture whereby residents’ relations to the city and the atmospheric become vulnerable to transformation, here, too, the

Reforested trees in a fog oasis ecosystem in Villa María del Triunfo.

Photo: Chakad Ojani, Winter 2019.

affordances of the materials to be captured reshape socio-political realities in ways not immediately evident.

The same holds true for any infrastructure, for if infrastructural (dis)connections extend beyond gray materials to enfold forests (Carse 2012), rice (Morita 2017) and air (Vonderau 2019), then this also means that infrastructuralization always holds an element of reciprocal capture: a dual process of co-emergence whereby humans, materials and other-than-human actors enfold references to one another in their own constitution (Stengers 2010: 36). The contingency entailed by such mutuality needs to be acknowledged in order for urban bioinfrastructures to move beyond paradigms of control and become more than just another socio-technical fix.

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Soft Lines: Shorelines and Surfaces

Sarah E. Vaughn

Surviving climate change requires care for shorelines. Anthropology has offered much scholarship on the infrastructural interventions that make the boundaries between land and water imaginable. Attention to shorelines becomes an important entry point for understanding the conflicting geopolitics of climate change and related adaptation projects. More than rendering visible a quantitative measure of change, shorelines are cultural artifacts. A specific insistence of lines that converge at multiple points, shorelines draw together varied movements and gestures. And rarely do shorelines conform to one kind of surface, whether of materials, environments or bodies.

Perhaps some of the best-known innovators and excavators of shorelines are the engineers who construct sea defenses. Building on Tim Ingold's (2016) insight that lines are a platform for generating surfaces, this photo essay charts the cultural meanings

of lines that emerge from engineers' efforts to adapt groynes – a type of sea defense – to rising sea levels and erosion in Guyana. Throughout, I use the images to ask: what if humans treated shorelines as a history of surfaces? My proposition is that, if we did, then the practice of caring for shorelines may amount to something other than a reflection on the forms of injury and damage that derail daily life. Instead, we might begin to encounter shorelines as sites of creativity that are already thriving in staggered and surprising ways.

↓ *A typical concrete groyne in Guyana.*
Photo: Sarah E. Vaughn, 2014.

↓ ↓ *Fisherman mending a net.*
Photo: Sarah E. Vaughn, 2014.





Built perpendicular to the shoreline, groynes trap sediment with the intention of slowing down, halting or even reversing erosion. Most are constructed of concrete, or sometimes robust wooden planks. When sediment and sand accumulate behind a groyne, this does not mean that coastal land is completely immune from erosion. Other lines are being composed in the sand, and these may counteract the role that groynes are intended to serve.

Woman standing on a seawall near a mangrove forest.

Photo: Sarah E. Vaughn, 2014.

I encountered groynes while doing fieldwork in Guyana between 2009 and 2019. The engineers there were advancing the climate adaptation of sea defenses along the Atlantic coastal plain. Alongside a broader system of flood management, they were desperately trying to protect critical habitats and land-uses. Fisheries, mangrove forests, both formal and informal housing, roads, trails, boatyards, stray animals and dump sites all coexist along this coast.

A byproduct of ecological, social and technological relations, shorelines converge with other lines, even as people work hard to keep them distinct. Tim Ingold (2016) writes that lines have a genealogy: inclusive of a broader history of language and representation, lines are everywhere. Whether the decorative patterns of Papua New Guinean art or traditional Navajo blankets, lines impose patterns onto surfaces. Likewise, Dominic Davies (2023: 66) notes that “capital’s ideal of the ‘straight’ infrastructural line,” has historically reinforced moral ideas of progress and patriarchy. As Ingold reminds us, lines are never simply physical indentations. They “crystallize” prior activities and events (Ingold 2016: 66).

I take Ingold’s provocation as a starting point for considering not only the ontology of lines but what they do to the world. Guyana’s shoreline also radiates from and draws on numerous histories. The perhaps best known of these emphasize Amerindian ‘mound cultures’ and Dutch and British ‘plantation societies’. Mounds in this case

are not so different from the polders integral to coastal engineering in modern-day Guyana. Both transform earthy terrain into littoral infrastructure. This is the case even though Standard English describes these phenomena in different geometric terms. One surface is a curve (mound); the other is a plane (polder). And yet, these different surfaces serve the same purpose in coastal protection. They are cultural designs that remind humans of their coexistence with an unruly shoreline.

Since the early 2010s, Guyanese engineers have attempted to capitalize on the potentials of the redefinition of surfaces. They have experimented with soft groynes – structures made of geotextile, a flexible and permeable fabric that encases tons of sand. The idea behind these designs is that soft groynes will naturally reinforce the shoreline’s existing sandy terrain while preventing excessive erosion in the face of rising sea levels.



← Typical soft groyne in Guyana.
Photo: Sarah E. Vaughn, 2014.

↓ Coastal mud at low tide.
Photo: Sarah E. Vaughn, 2014.





↑ *Seaweed on the surface of a soft groyne.*
Photo: Sarah E. Vaughn, 2014.

← *The bend of a soft groyne.*
Photo: Sarah E. Vaughn, 2014.

Soft groynes blend into the shoreline in more aesthetically appealing ways than concrete or hard groynes. Geotextiles are black – a color that complements Guyana’s naturally muddy shores under the right conditions, especially as the sediment that encrusts on it offers a home for seaweeds and certain marine organisms. Moreover, as waves influence the shape of soft groynes, with time they may no longer appear straight. Instead, they come to resemble gigantic sea creatures, wiggling their way out of the ground and into the Atlantic. Engineers responded to this movement with great interest. As one explained to me in 2014: “We haven’t been focused much on what groynes actually do to the coast – we haven’t [yet] learned to appreciate them.” For instance, soft groynes are intended to have little environmental impact because, as the geotextile wears away over time, the remaining sand consolidates as beach. Yet, after numerous experimental constructions in Guyana’s capitol city of Georgetown,

engineers learned that geotextile has a tendency to rupture under the force of powerful waves and storm surges. Likewise, soft groynes must contend with the daily obstacles of urbanism: litter, sprawling development, wear and tear from beach users. Within a year of their experiments beginning, engineers retired soft groynes and went back to the drawing board. They therefore categorize soft groynes as having a relatively short design life – the period an infrastructure functions before it fails, breaks or becomes a liability. By contrast, the design life of groynes and seawalls built of concrete is fifty years in Guyana.



Beach in Georgetown.
Photo: Sarah E. Vaughn,
2014.

On the Guyanese coast, engineers are learning to work with erosion rather than against it. Their intention is to design soft groynes that can coevolve with Guyana's fluctuating shoreline and patterns of urbanization. They perceive sea defense as a dense web of fragmented lines. Ingold (2016) has argued that the link between lines and surfaces is the act of inscription or efforts to mark or leave a trace. Inscription has been associated with what he calls the desire to express meaning, particularly the idea of "point-to-point connections" (Ingold 2016: 3). For Ingold, lines and surfaces tell a great deal about what the world is and what one aspires for it to become. Even still, there are just as many "historical sources of the straight line," as there are examples of nonlinearity and the doubt sowed by the failures of modernism (Ingold 2016: 4). Engineers' engagements with soft groynes offer insight into how people are creatively reinventing and experimenting with fragmented lines in the midst of climatological ruin.

With their appreciation for the nonlinearity of shorelines, the efforts of structural engineers in Guyana reminds us that climate change has already imposed restrictions on daily life. While much can be said about the dire futures that might be in store, shorelines reveal that plans calling for business as usual as well as a so-called radical otherwise both have expiration dates. One way of pursuing future ethnographies of shorelines would thus be to explore the varied ways surfaces come to matter and gain traction in adaptive responses, and to ask how surfaces come to represent certain people, places and things as worthy of integrating into our understandings of climate change and social histories of the engineering sciences.

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Ecosystems are Filters:

River Restoration as Urban Experimentation

Raúl Acosta

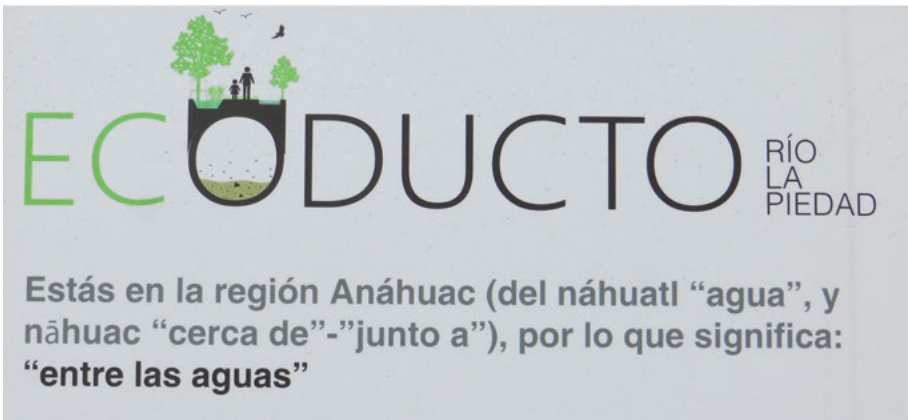
Urban river restoration has been paraded in the last few years as a strategy through which cities may gain green credentials alongside benefits like climate change mitigation and public health enhancement, as well as the promotion of tourism and commerce. As cities continue to grow in size and significance – especially in the Global South – green and blue areas, referring to plant and water ecosystems, are increasingly appreciated among city-dwellers and policymakers as nature-based solutions to urbanization problems. One of the key characteristics that is sought in blue and green infrastructures – that is, the uses of other-than-human lifeforms to support human-centred systems – is their capacity to filter out materials, sounds and sun rays. I contend that by enhancing fluvial ecosystems, which are relational life systems, the resulting filtering capacities may go beyond the intended utilitarian purposes and also filter outcome-based planning, thus opening up possibilities for fertile ecological chaos. Top-down urban design often envisions gentrification processes to produce highly desirable urban developments in order to attract affluent individuals and investment. Recent bottom-up initiatives, on the other hand, tend to prioritize ecosystems in order to spur healthier interspecies relations in the pursuit of ecological and social justice.



The case I use to exemplify this process is a linear park in Mexico City, named Ecoducto, which was set up along a 1.6 km stretch within the central reservation of a twelve-lane avenue. I consider this to be an instance of bottom-up subversive experimentation because it was launched by activists and civil society organizations who promoted its creation as a first step towards the restoration of the river that originally flowed where the avenue is situated today. The main group behind its conception, Cuatro al Cubo, is part of a new wave of activism in Mexico that combines expert knowledge with agendas for change. Specifically, Cuatro al Cubo promotes a type of urbanism that seeks

Area of Ecoducto closed to the public where sewage is filtered as it waters the plants along the linear park.

Photo: Raúl Acosta, January 2019.



Ecoducto logo, depicting the sewage with the linear park above it.

Photo: Raúl Acosta, January 2019.



← Tanks to process sewage and remove toxic material.

Photo: Raúl Acosta, January 2019.

↓ The linear park in sunshine.

Photo: Raúl Acosta, January 2019.



to reverse environmental deterioration – in particular by restoring urban rivers and fluvial ecosystems. As has been common in many cities around the world, the river in question – La Piedad – first became an open sewer and then was canalized (culverted) in order to build the avenue Viaducto Presidente Miguel Alemán. Crucial to Ecoducto is that the sewage that now flows below the avenue is part of the experiment, as some of it is redirected up to the surface to hydrate the linear park. For this to happen, a series of natural filters – that is, rocks, sand, plants and bacteria – are set up in order to clean the water then used to irrigate the 4,800 square metres of vegetation. This is a process that emulates wetlands, known as ‘Earth’s kidneys’ for their capacity to purify water.



Scented flowers in the park.

Photo: Raúl Acosta,
January 2019.

As I walked through the park, I was surprised not to hear the traffic in the jam-packed thoroughfare around me. This was partly because the average speed in the city is not high and also because people do not honk their car horns as frequently as they used to. But crucially, the plants served to buffer the constant noise of traffic. I observed the contrast before going into the park and shortly after leaving it. I also noticed that I could breathe without feeling I was taking in the noxious gases that abound in Mexico City. On the contrary, scented plants like lavender helped make the experience more enjoyable. I even felt the air I inhaled was almost as fresh as that of Chapultepec, one of the city’s most densely treed parks. Ecoducto runs alongside two highly gentrified neighbourhoods, Escandón and Roma Sur, which means it is already situated in a relatively affluent setting for Mexico City. Nevertheless, the potential subversion of Ecoducto is not only about what it can signify in its locality, but in the city more widely. This has to do with its political dimension.

Filter Bioinfrastructures

Waterways have been central to human civilization. Concerted efforts to control water flows for agriculture, production and consumption laid the groundwork for political systems throughout history. Wittfogel's hydraulic hypothesis, for example, correlates large-scale irrigation systems with autocratic leadership in ancient states (Obertreis et al. 2016). More recently, water management has been related to an early form of the modern bureaucratic state in the Netherlands, where collaboration in water boards laid the foundation for consensus democracy (Hendriks 2010: 71). The restoration of urban waterscapes in our time, however, reflects novel forms of political transformation. This could be yearnings for improved governance models (Rademacher 2011), or opportunities for multispecies cooperation (Brierley 2020) and planning (Morgan 2019).



One of the ponds in Ecoducto.

Photo: Raúl Acosta, January 2019.

In using plants as filters of sewage, airborne toxins and of sounds, Ecoducto is an experiment to prove what river restoration could achieve. Furthermore, along its main path there are numerous informative signboards with illustrations of the plants that make up the park and the micro-organisms that abound in its miniature wetlands. The team in charge has sought to explain the complex interactions taking place here between materials and other-than-human lifeforms. They combine scientific information with references to cultural understandings of ecological relations among Indigenous peoples in the region. In this way, the experiment is also educational: advocating for a renewed appreciation of ancestral knowing together with scientific insights in the context of the megacity. Ecoducto is thus a living example of multispecies conviviality, or the interaction among species that is not merely coexistence but implies a mutual transformation, a “becoming-with” (Rigby 2018: 77).

Urban infrastructures are usually considered as the elements that provide a basis for human-centred structures or systems – like those dedicated to communication or transport – to operate, in both technical and utilitarian terms. They are the “material enablers for (primarily) human flourishing” (Kanoi et al. 2022). With the recent consideration of green and blue infrastructure – that is, of plant- and water-based ecosystems as infrastructures – communities of organisms are therefore also regarded in technical and utilitarian terms as offering services to humankind. However, if we consider green or blue infrastructures not in technical and utilitarian terms but rather as necessary elements of urban ecosystems, then the picture changes. By employing the term ‘bioinfrastructures’ we seek to acknowledge infrastructures as intrinsically lively (see [Introduction](#)). Perhaps cities themselves can be rethought not only as using ecosystems but rather as ecosystems themselves (Acosta et al. 2022), made up of intricate biostructures that we have so far failed to consider. Urban design, civil engineering and architecture have often prioritized an increasingly stark separation of the materials and life spheres that continue to enable the human organism as if it was not part of a set of ecological relations. Yet if green and blue infrastructures are considered as merely service providers, then we run the risk of ignoring cycles of decay and growth that all life necessarily engages in.



An informative sign, situating Mexico City within the broader catchment area where the original lake system was. Photo: Raúl Acosta, January 2019.

What I believe the Ecoducto experiment demonstrates is that in connecting the matter and flows necessary for life, one learns that everything already there – human-made or otherwise – is also part of such ecosystems. Imagining the restoration of a river in Mexico City entails rethinking how the city itself can relate to its own complex water history. It is well known that the megalopolis is sinking. The lakebed on which it grew has been drained to such an extent that buildings, streets and avenues are gradually descending (Vitz 2018). Learning how to restore ecosystems entails a type of

multispecies justice that also sheds light on social inequalities. This train of thought is captured in the signboard that shows the stages of Ecoducto: its beginnings in the form of picnics as protests demanding action; an initial restoration with traffic lanes down the sides; and the full restoration with just cycleways along the sides. Hence, it is not another case of green gentrification, where new green spaces serve to expel poorer inhabitants, but rather an effort to make the restored urban landscape work for all city dwellers, regardless of income or status.



A signboard showing the stages that activists hope for Ecoducto: from initial picnics demanding action, to the final stage of river restoration.

Photo: Raúl Acosta, January 2019.

The urban chaos that is Mexico City is the product of decades of improvised policies by the semi-authoritarian single-party regime that was in power for most of the twentieth century (Davis 1994). Ecoducto reflects a yearning for more inclusive forms of development, open to all urban dwellers and not just the affluent. Although quite small in the grand scheme of a megacity, it represents a hope of engaging ecology with cultural memory, so that city dwellers, commuters and visitors can feel part of an urban transformation. I wonder if bioinfrastructures may end up unravelling the predominant model of subsuming nature to human-centred designs, by showing how ecological relations reflect the need for multispecies and social justice that in turn informs a life-based urbanism.

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A Biotoilet for the Future?

Mwangi Mwaura and Mary Lawhon

What can a toilet tell us about people's understanding of ecology, their relationship to their surroundings, their aspirations for urban life? Toilets are mundane objects, a place where people go to do private business, a task we often prefer to think and talk about as little as possible. Yet toilets are also a key site where bodies and ecosystems connect and a useful space from which to rethink what infrastructure is, or ought to be.

Modern toilets that flush and are connected through a sewer to a water treatment facility have long been imagined as the pinnacle of sanitation, part of the modern infrastructure ideal of a uniform, universal infrastructure network (Graham and Marvin 2001). Yet there is an equally longstanding – and, in the context of ongoing environmental crises, a growing – sense that there is something flawed, something 'unnatural' about the modern imaginary. There might be a need to imagine, and act, differently (Lawhon and McCreary 2023; Lawhon et al. 2023).

This essay draws on participant observation and interviews at a biotoilet that has been in operation for ten years in Mathare, an informalized settlement in Nairobi. Mwangi conducted interviews for seven months in 2023 with members of Twaweza (Swahili for ‘together we can’) youth group who manage the toilet. Here, we explore tensions between a hope-filled new narrative in which bioinfrastructure enables more sustainable urban lives and resources remain under local control, and actual experiences of bioinfrastructure that require unreliable resources and relationships.

In Mathare, we can already find the coexistence of diverse off-grid sanitation models (Thieme 2017). While some still consider these to be placeholders as people wait for modern flushing toilets, others articulate a different pathway, one rooted in no longer waiting for modernity. Such toilets are infrastructures “of the now and the future” as one of our interlocutors stated in a focus group discussion in April 2023.

The sanitation configuration we focus on here includes an ablution block intended to produce two key benefits: green energy from the waste would fuel a cooker, and a biodigester would make faecal sludge that is no longer a health risk and can be used as nutrient-heavy compost. To most of those we spoke with, the necessity of toilets was evident: they would reduce open-air defecation and the flying toilet menace that had been prevalent in the area. What kind of toilet should be constructed, however, was less clear. There are, undoubtedly, politics to these decisions: who is to build what, how should a toilet be owned and maintained, and what happens to the resulting sewage are all questions with political and economic implications. They are underpinned by power-laden assumptions about what sort of infrastructure is ‘appropriate,’ plausible, affordable and deemed to be green (see Morales et al. 2014; Jackson and Robins 2018). Who gets to decide what sanitation arrives is often not entirely straightforward, but our respondents note that this particular toilet is related to their support for a local politician as well as European development funding. We are therefore mindful that the arrival of the toilet involved a complicated interplay of agents and agency. Further, we are cognizant of the limits of data and aware of the interests of our interlocutors: these are not neutral actors, but entrepreneurs with vested interests in the success of the toilet. Our entry-point to the site was long after the toilet’s arrival, and thus what follows reports and reflects on how those managing the toilet have come to narrate it.

At the beginning of the project, our respondents noted that most of the members were optimistic and curious about the possibility of a biotoilet. However, it was the idea of “turning your waste into a resource” – as the project was pitched to them – that was most appealing. One member, who has since been nicknamed Fundi (literally ‘knower’ or ‘technician’) by the group for his knowledge of how the toilet functions, expressed that he was fascinated with the building design and its underground biodigester.

To build the requisite infrastructure, members volunteered their services under the guidance of engineers and technicians from the funding NGO and received training on operation, management and maintenance. The biotoilet has changed the surrounding area, reducing open defecation and flying toilets. It is generally seen as affordable: families and two churches near the toilet pay a monthly fee and children access it for free. The space outside has been turned into a garden and the hall on the upper floor provides a social space for local residents.

The members of Twaweza youth group view the toilet as a resourceful infrastructure thanks to its double benefits. As the group's chairperson explained: "It is not only a toilet where you shit and forget about your waste; you are aware the waste is a resource that produces gas which you can cook with." Here, then, through its metabolic system, the toilet is described as valuable infrastructure for the community. During our interactions with members, they regularly stated they would highly recommend the installation of more biotoilets in Mathare. Some even took this point further, hoping that more green infrastructures – beyond just sanitation – can be set up in the settlement. One member in particular, who is also a community activist remarked: "It is time infrastructure works to harness the resources we have with us here instead of washing them away." In such comments, as well as our wider conversations, we find a hope-filled narrative that emphasizes placing agency in local hands, utilizing local labour and knowledge rather than relying on outside support. This is a narrative underpinned by a belief in progress and the idea that a better future is possible, but it fundamentally differs from the modern infrastructure ideal's assumptions of uniform, universal access to a single network managed by external experts.

Our story does not end here: despite this positive rhetoric, there are plenty of problems with the biotoilet. While this bioinfrastructure is admirable and has been beneficial, it is also considerably more demanding of labour. A lot of maintenance is required which, as one member complained, would not be necessary for a toilet connected to

*Biogas toilet tunnel
cleaning at night.*
Photo: Mwangi Mwaura,
February 2023.



a sewer. The sludge tank has to be emptied every year, and in practice, this is done manually: members of the group use buckets to remove the waste. While the 'dry' sludge is supposed to be a resource in the form of manure, the group has never found a client for it. In the absence of someone else to help them close the loop, the sludge is put into the river.



The new cooker being designed at the jua kali workshop.

Photo: Kevin Ochieng (Twaweza Group), April 2023

Moreover, as is true for all infrastructure, some parts get broken and require repair, and this takes time and money. Unlike for more standardized infrastructure, however, the necessary parts sometimes take a long time to get hold of. For instance, for the last two years, the cooker has been missing. So, instead of using the gas as a resource, it has to be realized into the atmosphere periodically when it builds up. There is a sense of loss at the unavailability of this resource. The group is, however, in the process of acquiring a new cooker from a local *jua kali* ('technician workshop') who they have worked with in the design and making process.

Reflecting on the biotoilet and the associated labour leaves us with certain questions about nature, infrastructure and the future. From our conversations with those who work with and benefit from the toilet, we can find a hope-filled narrative of this infrastructure as being appropriate for the future, shifting agency and enabling more local access to resources. They see the metabolic labour of the toilet producing energy and bringing waste back into circuits of value as particularly beneficial aspects, in line with utilitarian green perspectives. The toilet is no longer new, but those working with it are also clear that it is a work still in formation: more is needed for this toilet to fulfil this potential. Knowledge and learning are crucial here, but what is sought and produced is not ivory tower theory; it is ways of innovating to make use of the knowledge, skills and materials already in the settlement. But connections are also essential: while there is a small garden associated with the toilet that acts as a social space (see Gonzalez 2021), there is a need for someone who wants the sludge, and a way to move it.

The biotoilet can be understood as part of ongoing shifts in thinking about what a good infrastructure configuration is, and can be, and the tensions involved in working towards infrastructures of the future. Good infrastructure, in this narrative, does not rely so much on elsewhere – neither the state to provide pipes nor hinterlands to manage the waste, even though there is an awareness that this might well be, on the whole, easier for those who work with the infrastructure. Yet good infrastructure cannot really be fully ‘localized’: in settlements of this density, sludge must go elsewhere; knowledge or parts from other places are needed to keep the cooker running. For now, those working with the infrastructure resourcefully make do while actively working to create a better infrastructure for the future.

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Growing Houses: Fusing Nature and Culture in the Early Twentieth Century

Sonja Dümpelmann

Linguists have suggested that in the Indo-Germanic languages ‘building’ and ‘growing’ share etymological roots. Furthermore, it is no coincidence that the German word for tree, *Baum*, which has been documented as existing since the eighth century, can be traced back to the West Germanic *bauma* and the Old English word *bēam*. These referred both to a ‘beam’ and to a ‘tree’. As if giving physical expression to these shared origins, in the 1920s the German garden architect Arthur Wiechula (born Wichulla) proposed to literally cultivate houses using fast-growing tree species such as poplars or other species depending on site conditions. As quirky and unrealistic as it may seem today, this was hardly a new idea in the early twentieth century. It is also a concept that architects have returned to more recently.

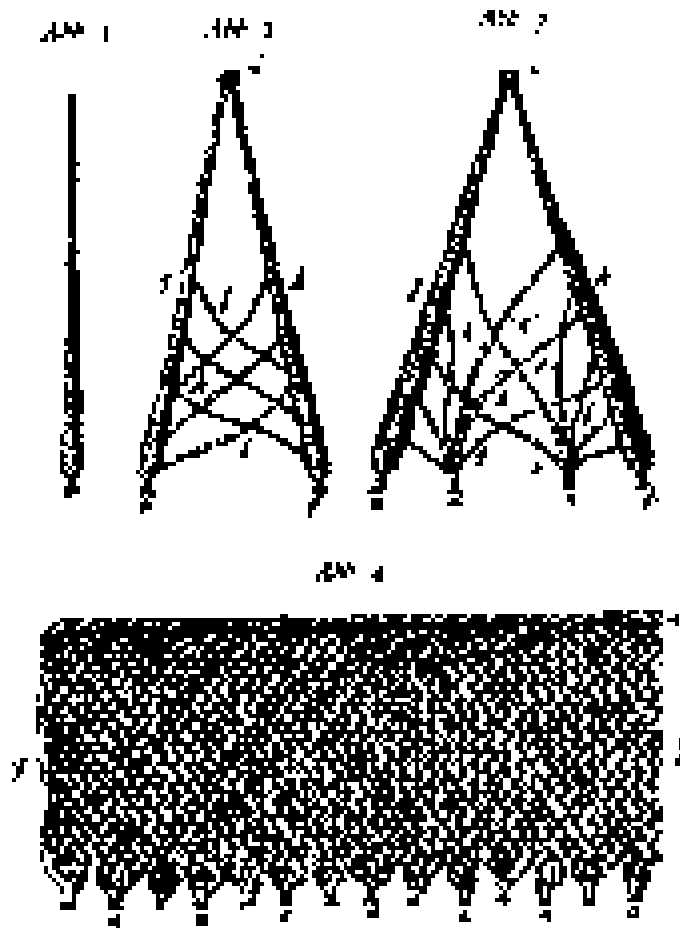


The hypothesis of architecture's vegetal origins has captivated the imagination of architectural theorists since Vitruvius in the first century BCE. It famously inspired the eighteenth-century French Jesuit Abbé Marc-Antoine Laugier to declare the primitive hut consisting of tree trunks and branches as a prototype for basic rational architectural principles (Rykwert 1972). Today, researchers at the Technical University Munich are seeking to harness trees' physiological processes, material and growth in the creation of built structures, not dissimilar to what Wiechula envisioned one hundred years ago and referencing his work (Ludwig and Schoenle 2022). Developed in early twentieth-century Germany, characterized by the politics of austerity, efficiency, internal (and external) colonization, nationalism and globalization, Wiechula's ideas literally enlisted nonhuman nature as collaborator.

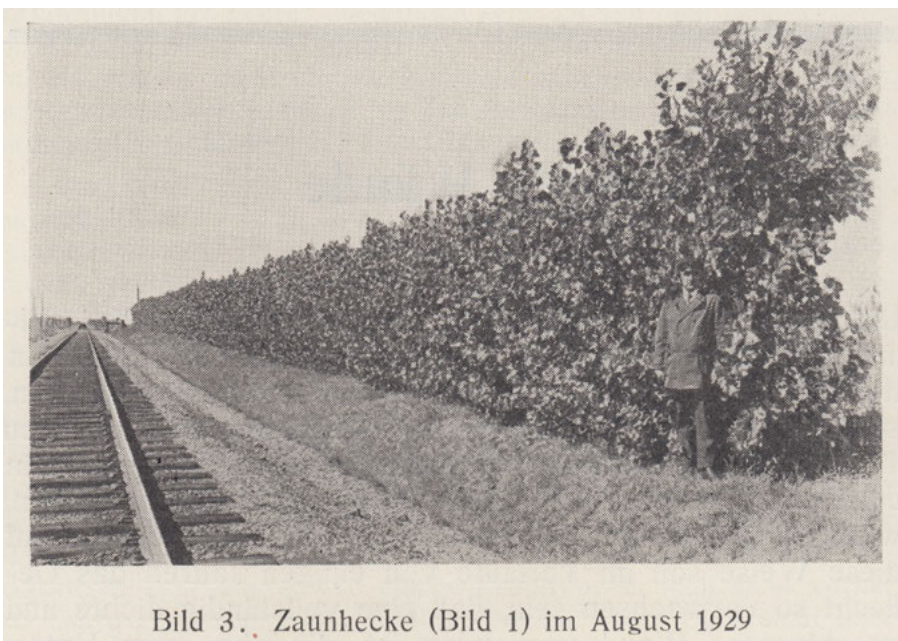
*Ingenhoven Architects,
hornbeam hedges
creating the facades of
Kö-Bogen II in Düsseldorf.*
Photo: ingenhoven
architects / HGEsch

Wiechula self-published his ideas for 'growing houses' (*wachsende Häuser*) in 1926, after he had patented designs for growing snow fences, creating walls out of living wood, connecting tree parts and for a special tree clip to facilitate the growing-together of wood.¹ In that same year, the German National Railway, which was swiftly developing into a technologically and economically successful state-owned enterprise, planted a test strip of Wiechula's snow fence in Barleben near Magdeburg. The tender branches of young trees placed at regular intervals parallel to the railroad were interwoven to create a dense thicket and to fuse together. Three years later, the experiment was reported as having produced promising results (Renz 1930). As self-proclaimed 'nature building engineer' (*Naturbau-Ingenieur*), Wiechula refuted critics who considered his fences too labour intensive, expensive as well as ineffectual, and who argued for more conventional lattice or new concrete fencing (Richter 1929; Schneider 1929; Sieh 1929).

¹ Deutsches
Reich, Patentamt,
Patentschriften nos.
386940, 433298, 459870,
459996.



Arthur Wiechula,
illustration of a snow
fence made out of woven
shrubs, patented 1 April
1922.
Deutsches Reich,
Patentamt, Patentschrift,
no. 386940:
Schneeschutzzaun aus
verflochtenen Pflanzen.



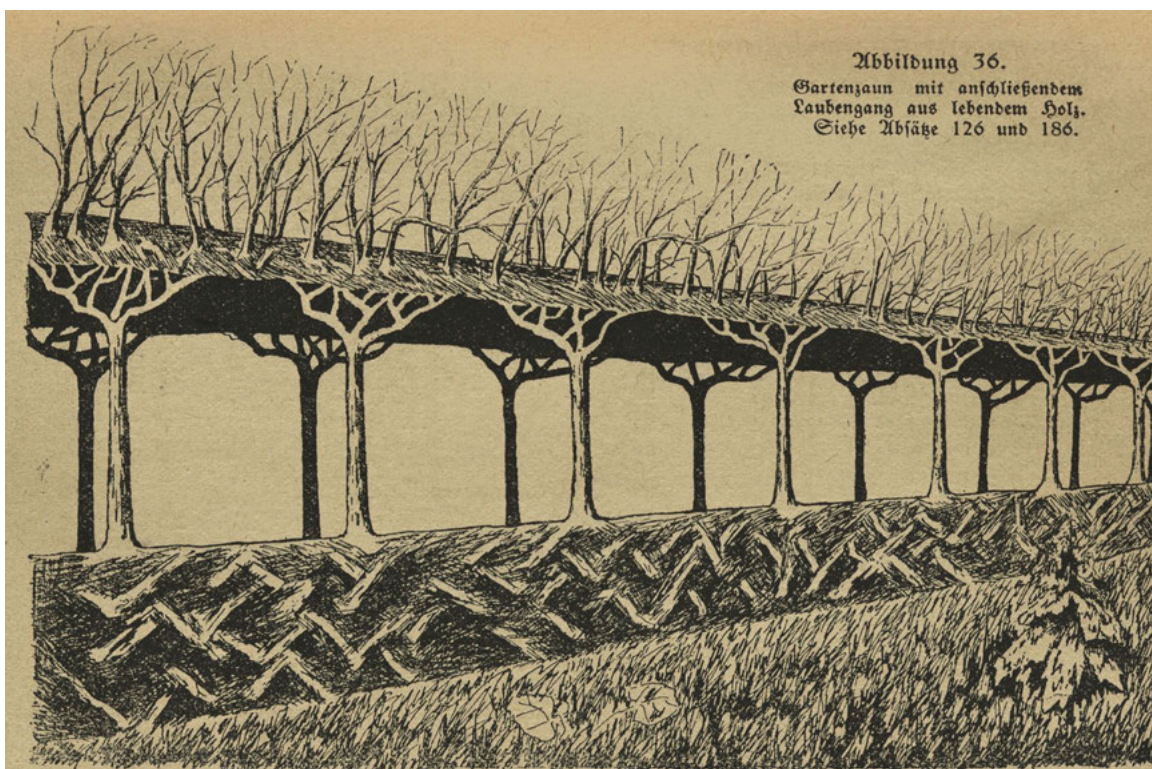
Test strip of Wiechula's
snow fence along the
railway line in Barleben
near Magdeburg, 1929.
Renz 1930: 86.

Instead, he advertised his snow fences as denser and more compact than natural hedgerows. Furthermore, after the initial work of planting and weaving, the beautiful living fences would maintain themselves, while regular pruning could also produce valuable firewood.

Although the snow fences were the most pervasive and long-lasting of his few planted (infra)structures, Wiechula's imagination encompassed a world in which bridges, station roofs, covered walkways, toolsheds, stables, barns and even houses would be grown out of trees. He illustrated this fantastical realm in elaborate drawings while explaining the physiological processes that, according to him, would make it possible. 'Nature buildings' (*Naturbauten*) were not only beautiful, less susceptible to fire and earthquakes, but also provided health benefits (Wiechula 1926: 286–92). First and foremost, however, they were producers rather than consumers of material. The economy of nature was central to Wiechula's idea of nature buildings. In contrast to conventional built structures, growing houses consisted of living substance continuously producing value. From the minute they were planted they increased the land value through their beauty and wood production, and even after many years maintenance costs would be low (Wiechula 1926: 40). Wiechula used this argument to refute criticisms about the time it would take to grow the structures. As a landscape gardener he knew all too well that time stood in the way of the gardener's art being considered on a par with the art of building (Wiechula [Wiechulla] 1902: 33–34). Also trained in fruit-growing and horticulture, he was well versed not only in pruning, grafting and creating espaliers, but also in tree and especially plantation economics, even publishing an entire volume on the subject (Wiechula [Wiechulla] 1905). Wiechula had experimented with nature

Arthur Wiechula, garden fence and covered walkway grown out of trees.

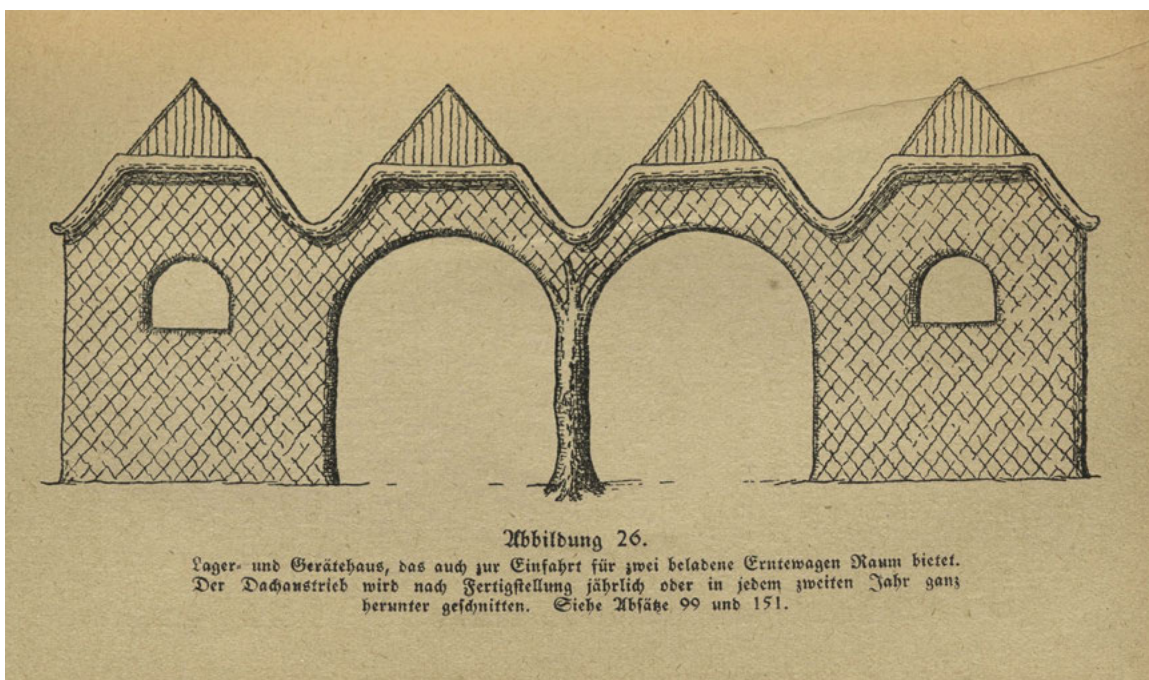
Wiechula 1926: 137.



buildings before the First World War but asserted that it took the postwar scarcity of materials and the turmoil in the mortgage market to induce him to share his thinking more widely (Wiechula 1926: 286–87). As products of both nature and culture, nature buildings developed by pairing the force of nonhuman nature with human manual labour and scientific expertise (Wiechula 1926: 303). Although he liked to emphasize their innovative character, Wiechula's general ideas about employing plants' life force in utilitarian construction and engineering efforts were not without precedent. Vegetation and environmental engineering technologies – today often referred to as nature-based solutions – had already been used for centuries, for example in riverine erosion control, coastal land reclamation and the construction of roads.

Wiechula's ideas were further disseminated by the publication of *Holzhäuser unter Mitwirkung der Natur* ('Woodhouses in cooperation with nature', 1927) in a popular series of handbooks entitled *Wie baue ich mir selber?* ('How do I build for myself?'). As suggested by its attenuated title, woodhouses were a popularized, condensed version of growing houses. The ideas also made it into the review pages of major horticultural and gardening journals, but many contemporaries remained sceptical of the high-flying proposals and of what – according to one reviewer – promised to become aesthetic 'monsters' (Anon. 1926a). Another reviewer saw his doubts legitimized by the lack of photographic evidence. The concept simply appeared too unrealistic (Anon. 1926b). Wiechula's overbearing self-promotion did not help his cause, and many either cast him off as self-interested impostor, or more benevolently as an unrealistic optimist (Steffen 1921). The private limited company he ran in the 1920s from his home in Berlin-Friedenau ultimately collapsed and his patents were acquired by the Neulohe company, which throughout the 1930s concentrated on the production of living (snow) fences for railroads (Herr 1931, 1933a and 1933b).

Arthur Wiechula, growing storehouse and toolshed.
Wiechula 1926: 109.



Wiechula's utopian ideas were infused with romanticism and displayed a vernacular techno-optimism. His nature buildings were literally and figuratively grounded in their respective site and environmental context, while also based on a belief in human progress and the triumph of scientific invention. Consequently, he made sure to patent his putative inventions, be it a living snow fence or a special check valve for water supply and drainage systems (Wiechula [Wichulla] 1902: 16). Besides their use in Germany's infrastructural development, Wiechula also planned for his nature building technologies to be employed in cooperative settlements. Jumping on the wave of Imperial Germany's settlement movement and internal colonization, Wiechula had since the turn of the century promoted the conversion of old estates into self-sustaining small-farm cooperatives, an idea that in 1920 he considered best supported by the Großdeutsche Freiheitspartei (Greater German Freedom Party), a small völkisch party that shortly thereafter united with the national-liberal Deutsche Volkspartei (German People's Party).² In contrast to other settlement concepts redolent with antiurban sentiment, Wiechula sought to attract members from all classes, claiming that a move back to nature did not have to imply a move away from culture and civilization (Wiechula 1916: 50).

² Advertisement for the party on the last page of Wiechula 1920.

The fusion of nature and culture was key to Wiechula's philosophy, including his belief in a linear concept of progress and development. In this theory, horticulture – including fruit-growing and growing houses – was the most civilized form of cultivation. It trumped agriculture because it was the most efficient, productive and beautiful form of land use (Wiechula [Wichulla] 1902: 1–19). This was a convenient and perhaps even instrumental argument at a time when state officials, first during the German Empire and then the Weimar Republic, were using land parcelling and settlement to aggressively 'Germanize' and 'civilize' large parts of what they called Prussia's Eastern Territories (Conrad 2014). The large-scale agriculture of former Polish estates there would be replaced with what Wiechula suggested was a more 'civilized' fine-grained garden culture of the German settlers. The inherent contradictions in his arguments for free trade and colonization as harbingers of world peace and the overcoming of purported racial difference eluded Wiechula, as it did many of his contemporaries (Wiechula [Wichulla] 1905: 53–54, 230–31). His was a fantastical world built in cooperation with nature and in which human and nonhuman organisms would live in harmony.³

³ Wiechula 1916: 15, 25; Anon. 1926b.

Wiechula's growing houses were themselves organisms and an extreme manifestation of what anthropologist Tim Ingold would later call a "dwelling perspective" on architecture. By this Ingold means that all humans build, through processes of inhabiting or dwelling in their environment (Ingold 2000: 185–88). The form of an oak tree, which due to its ecological relationships has transformed throughout its evolution, is for Ingold "no more given, as an immutable fact of nature, than is the form of the house an imposition of the human mind" (2000: 187). He suggests that the distinction between the form-giving processes of tree and house are relative, depending on the extent of human involvement. Decades before, Wiechula had sought to merge the two, fusing nature and culture. His growing houses, whether as a crafty business idea, an expression of personal belief or a utopian vision, can also be seen to reverberate in aspects of some of today's green architecture.

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On Urban Photography: Infrastructure in a Minor Key

Maan Barua

When walking down a crowded *galli* in Old Delhi, the pedestrian negotiates rickshaws, cattle, bicycles and crowds. Yet this cramped space has an order. People walk with purpose. A pause means exchanging greetings with someone familiar. Those hanging out in the alleyway or outside shops are waiting... for something to happen, for a deal to materialize, or with no fixed intent. In the midst of the bustle, you hear someone shout “Hai!”. Your gaze tilts upwards to see a macaque clambering up a pipe, then onto a balcony, before crossing the busy street via electric cables proliferating in every direction. At this moment another city comes into view, an arboreal city where space expands via other-than-human propensities and where movement is freed from the usual conduits of mobility.

What if this image were a frame of reference for urban inquiry? Would it tell us something different about the material politics of infrastructure than what is evident in more established accounts (Larkin 2013)? This image, I argue, prompts thinking about urban infrastructure in a minor key – in a manner attentive to stories that are not necessarily tethered to a human constant or fall back upon the usual questions of planning, design and assembly. The minor is a language of rearrangement and variation. It takes urban worlds in a direction different to those dictated by an established canon (Deleuze and Guattari 1986a). And it is these variations that make the minor political, for it indexes other ways of negotiating access to infrastructure (Barua 2023; for minor accounts of cities, also see: Sundaram 2010, Niranjana 2022).

Inventing Lines. Macaques forging new urban pathways as they move using electricity cables.
Photo: Maan Barua, 2020.



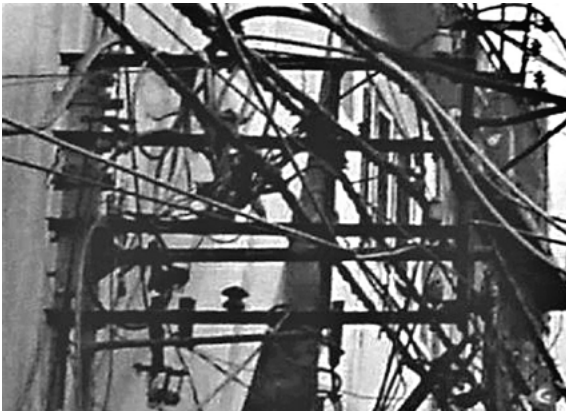
Let us return to the photograph. What I aimed to hold within frame, using my mobile phone camera, was the animal's mobility and the tangle of wires – abstract lines that curve in different directions, knot into one another, only to unfurl in new ways. Using a mobile phone, rather than a professional camera, was an attempt to work with a device that increasingly mediates urban experiences, including those of my interlocutors. Through the optic so generated, the city becomes “a confusion of cables” (Flusser 2005: 326), where the ambit of one set of infrastructures is overtaken by improvisational assembly. The electrification of Delhi has in fact proceeded through a complex intersection of state ritual, political action and legal struggles (Coleman 2017). The proliferation of wires – raveling here, unraveling there – is the outcome of practices of hooking onto the energy grid via improvised, and sometimes unauthorized, connections. This has been partly spurred by a rapid spread in unplanned settlements and, concomitantly, an increased demand for energy. The formalization of such connections has been one process through which electrification has proceeded in the city (Criqui 2016).



*A Meshwork of Wires.
Hooking onto the grid via
improvised connections.*
Photo: Maan Barua, 2020.

Informal urbanism, however, does not attend to all of the currents this image brings to life. The electricity grid becomes a meshwork of wires through specific material practices of urban electricians. The latter graft wires onto existing connections in order to reroute electricity. In contrast to an engineer, who works with designs, plans and the laws of voltage, capacity and load, the electrician is a bricoleur, operating through rules of thumb, rearranging wires in new and varying configurations. Their practices enact a minor politics, for they seek to evade scrutiny rather than openly contest capital and the state. “Completely stopping [such] theft,” a Delhi policeman remarks, “is not practically feasible.” Exact connections are difficult to ascertain during a raid. Local strongmen might intervene and hinder officials from carrying out inspections.

At the same time, the proliferation of wires creates opportunities for macaques to negotiate the city. These animals are predominantly ground-dwelling but, in cities, will move using cables, walls and rooftops. By repurposing such infrastructure, macaques have shifted from a rural terrestriality to an urban arboreality (Barua and Sinha 2022). Crossing roads via electric wires, however, is a variegated form of macaque mobility. Certain bold individuals, especially adult males, might be more disposed to doing so than juveniles or females with infants. The silhouette of the animal draws attention to a “haptic space” (Deleuze and Guattari 1986b: 492), forged through macaques’ tactile, and not just visual, encounters with the grid. The photograph below indexes how infrastructure furnishes habitat for the animals. Wires and cables allow macaques to climb onto balconies or sneak into houses to search for food – a commonplace occurrence in the city, which leads to considerable frictions with people. Dubbed Delhi’s “monkey menace” (Malik 2001: 169), the government has to date caught and relocated over twenty thousand macaques from the metropolis in the last fifteen years (Rajput 2018). Yet, efforts to create a macaque-free city have reached an impasse.



Macaques repurposing infrastructures to disruptive effect is only part of the story. They can also be enrolled by urban citizens to make claims on infrastructure. Several households in one of Delhi's lower-middle-class residential colonies resorted to abandoning the new electricity meters that a power distribution company had installed. Macaques, residents argued, had developed a habit of ripping off meters attached to the wall. When complaints were put forward to the police, the latter remarked that "theft laws are for humans, not macaques." The local power-supply entity apparently replaced more than fifty damaged or missing meters. Whilst it is difficult to ascertain whether macaques were the true cause in each instance – for it is plausible that people had surreptitiously removed them and deflected the blame onto the animals – there is no doubt that this represents subversions enacted by bringing other-than-humans into the fray. Here is a politics of infrastructural access in a minor key, for it involves acts of trying to evade regulation, albeit outside of what usually passes as political activity.

The enmeshments between other-than-humans and urban infrastructure are revealed by the photograph, partly because of the phone's limited capacity for zooming-in, forcing one to depict an animal in its surrounds. Such enmeshments are often taken to be epiphenomena in much urban theory. They are treated as subjects that reside within the city, but which are not really worthy of serious enquiry. Animals are seen as transgressive forces that disrupt the workings of infrastructure, but not necessarily as agents that constitute part of the material politics of infrastructural maintenance and repair (Bondt and Jaffe 2022). In one of the close-ups above is a transformer, towards which the macaque seems to be moving. This was not a deliberate part of the frame: rather the transformer became evident only after having taken the photograph. Nonetheless, the transformer also allows for extending this story of the urban in a minor key. In Delhi, there have been several cases of macaques tripping power lines and transformers. During such instances, members of a macaque's natal troop can prevent repair personnel from removing the injured or electrocuted animal, causing further delays to the restoration of electricity. Nowadays, power suppliers have begun to collaborate with conservation and animal welfare NGOs, who provide assistance when repair personnel are at work (Anon. 2018). Such developments show how animal–infrastructure enmeshments are being recognized in practice and have implications for infrastructural maintenance and repair in the lived city.

← *Transformer. Practitioners are aware of animal–infrastructure enmeshments for they have bearings on the maintenance and repair of the electricity grid.*
Photo: Maan Barua, 2020.

→ *Haptic space. Tactile encounters with the electricity grid alter the cartography of the city.*
Photo: Maan Barua, 2020.

Taken using a mobile phone, this photograph was produced under particular circumstances: while walking down a crowded *galli*, hearing someone shout “*Hai!*”, knowing that this could be the movement of a macaque and anticipating where it might go. The gaze tilts upwards, shifting the field of vision from a congested street, edited out by the camera frame, to the buildings with wires dangling overhead. One could say it was the macaque that led the photographer there, to an arboreal plane not always discernible when vision is fixed on the street.

But this shift in gaze does more. It helps forge another set of analytics that excavate a complex suite of agents, entities and forces engaged in the material politics of infrastructure. Such a politics of infrastructure needs to be articulated in a minor key, for what counts as political is not easily graspable through more established orders of thought and method. Furthermore, much of what is illuminated often operates under thresholds of detectability. A minor account of infrastructure might not entail grand explanatory schemas one associates with the urban canon. Yet, it is vital for comprehending the flexible strategies that render infrastructures accessible and which make the city habitable.

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The Parking Lots of Tallinn:

An Encounter with Marginal Ecologies

Matthew Gandy

Just a few metres from the Estonian Museum of Architecture in the city of Tallinn there is an ordinary-looking parking lot. A mix of temporary fencing and gravel surfacing near the harbour has produced a purely functional space that is criss-crossed by multiple ruderal ecologies. The idea of ruderal ecologies pulls in several different – if sometimes complementary – directions. A long-established strand encompasses botanical studies of marginal urban and post-industrial spaces from the middle decades of the nineteenth century onwards, which laid the basis for the flourishing of post-war urban ecology in many European cities. The term ‘ruderal’ itself is especially associated with the Sheffield-based botanist J. Philip Grime whose so-called CSR (competitor, stress-tolerator, ruderal) theory identified ruderal plants as those species especially well adapted to repeated forms of ecological disturbance (Grime 1977). From the early 1970s onwards ruderal ecologies have also featured prominently within a variety of cultural interventions, including new forms of nature writing that valorize the unexpected ecological dynamics of marginal or interstitial spaces (see Gandy 2022). More recently, the term ruderal has also been adopted within cultural anthropology to denote a postcolonial sensibility towards urban nature (see Stoetzer 2022).

As we enter the site on a bright morning in early June I am struck by a profusion of flowers growing along the strips of land that separate the parking bays from nearby construction sites. Attempts to flatten the space for cars have also produced small heaps of stony substrate that now support dozens of different species of plants. These linear piles of heaped gravel, with their self-selecting xerophytic planting schemes, are reminiscent of Japanese stone gardens or even landscaping features adopted for the rehabilitation of the Los Angeles river. In the case of a Tallinn car park, however, these spaces are not really intended for humans or non-humans: they are simply valorized voids suitable for the efficient temporary storage of cars. How they happen to look, or what forms of life they contain, are beside the point.

Parking lot near the Estonian Museum of Architecture, Tallinn. The author and environmental scientist Agáta Marzecová are testing out the Flora Incognita app for the identification of wild plants.

Photo: Maroš Krivy, 2023.



The economics of running a parking lot clearly do not extend to any kind of aesthetic concerns with landscaping; there is a certain indifference to the vegetal agency of such sites. Indeed, the apparent unusability of these multiple edge spaces poses a set of philosophical challenges for the interpretation of urban space. I am reminded of Gordon Matta-Clark's unfinished project entitled *Fake Estates*, dating from 1973, in which he purchased fifteen 'gutterscapes', including marginal slithers of land adjacent to parking lots, which were periodically auctioned off by the City of New York. Matta-Clark's interest in these places of extreme marginality can be regarded as a kind of experimental investigation into the limits of the urban land market. Curiously, in the early 2000s, in the wake of renewed interest in Matta-Clark's work, there were efforts by

artists and curators to lease the remaining sites as part of a wider reassessment of his artistic legacy. It is in spaces such as car-park edges that we encounter the ecological dimensions to the oscillation between use value and exchange value that underpins the cyclical characteristics of capitalist urbanization. These car-park ecologies are indirectly generated by the perturbations of capital and the material and conceptual edges to exchange value as a kind of porous frontier for perception and futurity. By inculcating a botanical mode of cultural valorization we are highlighting the arbitrary dimensions to aesthetic judgment, as Adorno once highlighted in his ironic contrast between the landscapes of Tuscany and the outskirts of Gelsenkirchen.¹

¹Adorno 1973 cited in Waldenfels 1985: 179.

As we wander around the site, we are engaging in a form of ecological loitering since our presence bears no relation to its primary purpose. Construction workers nearby steal an occasional glance in our direction. Car owners seem largely oblivious to our presence as they clutch their mobile phones in rapt attention. The blocks of stone and gravel support a rich variety of flowers, like carefully planted rock gardens: bright red poppies (*Papaver rhoeas*) contrast with yellow rocket (*Sisymbrium* spp.) and related plants such as field pennycress (*Thlaspi arvense*) and shepherd's purse (*Capsella bursa-pastoris*), while in places dense patches of the white-flowered common mouse-ear (*Cerastium fontanum*) are interspersed with bright blue speedwell flowers (*Veronica* spp.). A close inspection of more stony areas reveals dense clusters of yellow flowering stonecrop (*Sedum acre*), a plant that is commonly used for green roofs and other kinds of eco-design. Near the centre of a pile of gravel a lone figwort (*Scrophularia nodosa*), a species more associated with damp ground, presents something of an ecological puzzle.

These temporary ecologies driven by construction debris, ecological chance and the interweaving of human and non-human temporalities provide an ironic extension to the Estonian Museum of Architecture's 2023 exhibition *Urban stocks: spolia returns*, which considers the analysis of architectural materials as a form of deconstruction of the built environment. Contra the expansive mode of architectural theory à la Rem Koolhaas devoted to reconnecting architectural practice with the wider speculative dynamics of urban form, the *Urban stocks* exhibition highlights a different kind of multisensory architectonic taxonomy oriented towards the origins and properties of various materials. It is in this context that the ecological potential of gravel, stones and rubble takes on special significance.

These marginal spaces form part of the unnoticed ecologies of urban space yet clearly have greater floristic and aesthetic diversity than nearby municipal green spaces that are subjected to a variety of intensive management regimes including mowing, weeding and other attempts to control nature. The spontaneous or non-designed dimensions to parking-lot ecologies hold a closer affinity to 'wilder' ecologies towards the edge of Tallinn, such as the Pääsküla bog with its remnant ecosystem or the overgrown Paljassaare peninsula that has emerged out of abandoned landscapes derived from Cold War fortifications. Walking these parking lots evokes ghostly traces of previous landscapes portrayed in Andrei Tarkovsky's film *Stalker* (1979), with its oneiric excursions through strange and abandoned Cold War spaces in and around the city. Indeed, Tarkovsky shot much of his film in Tallinn, including sites near the old Rotermann salt storage facility that now houses the Estonian Museum of Architecture. Tarkovsky's depiction of the journey to The Zone – a mysterious destination where our innermost

desires can be realized – remains a luminous presence in what could be described as the collective cultural consciousness of the contemporary city. In cinematic terms, *Stalker* has become recognized as an early example of an emerging late-modern fascination with various kinds of geopolitical or post-industrial ruins but the film also serves as a more polyvalent meditation on time, decay and mortality, including forms of geopolitical haunting that pervade the present moment.²

² See, for example, Riley (2017) who adopts a hauntological approach à la Derrida for his analysis of *Stalker* in order to decentre overly auterist or neoromanticist modes of interpretation.

These traces of Cold War aesthetics have an eerie resonance with heightened geopolitical tensions in the wake of the Russian invasion of Ukraine: the harbour is now increasingly dominated by grey military vessels rather than tourist ferries connecting to Helsinki and other Baltic ports. Meanwhile, the seabirds wheeling overhead are loudly oblivious to the pervasive political unease. The symbolic resonance of Tarkovsky's *Stalker* in the contemporary city is indicated by the Stalker Alley of bars and restaurants located in the nearby Rotermann quarter. The arthouse film has become a distinctive cultural reference point for the ongoing valorization of urban space.³ But can a mere parking lot become a contemporary manifestation of Tarkovsky's interest in geographies of walking and serendipitous encounters? If such a place can offer some kind of ecological enchantment then what are the wider implications for how we conceptualize space, memory and the incessant agency of nature? Can a neo-Marxian emphasis on oscillating land values fully capture the richness of these unexpected socio-ecological constellations? What are the conceptual implications of slowing down and looking more closely at the intricacies of the non-human urban realm?

³ On the strange transformations of post-socialist Tallinn, including the use of ecological motifs in speculative urban development, see Krivý 2021.

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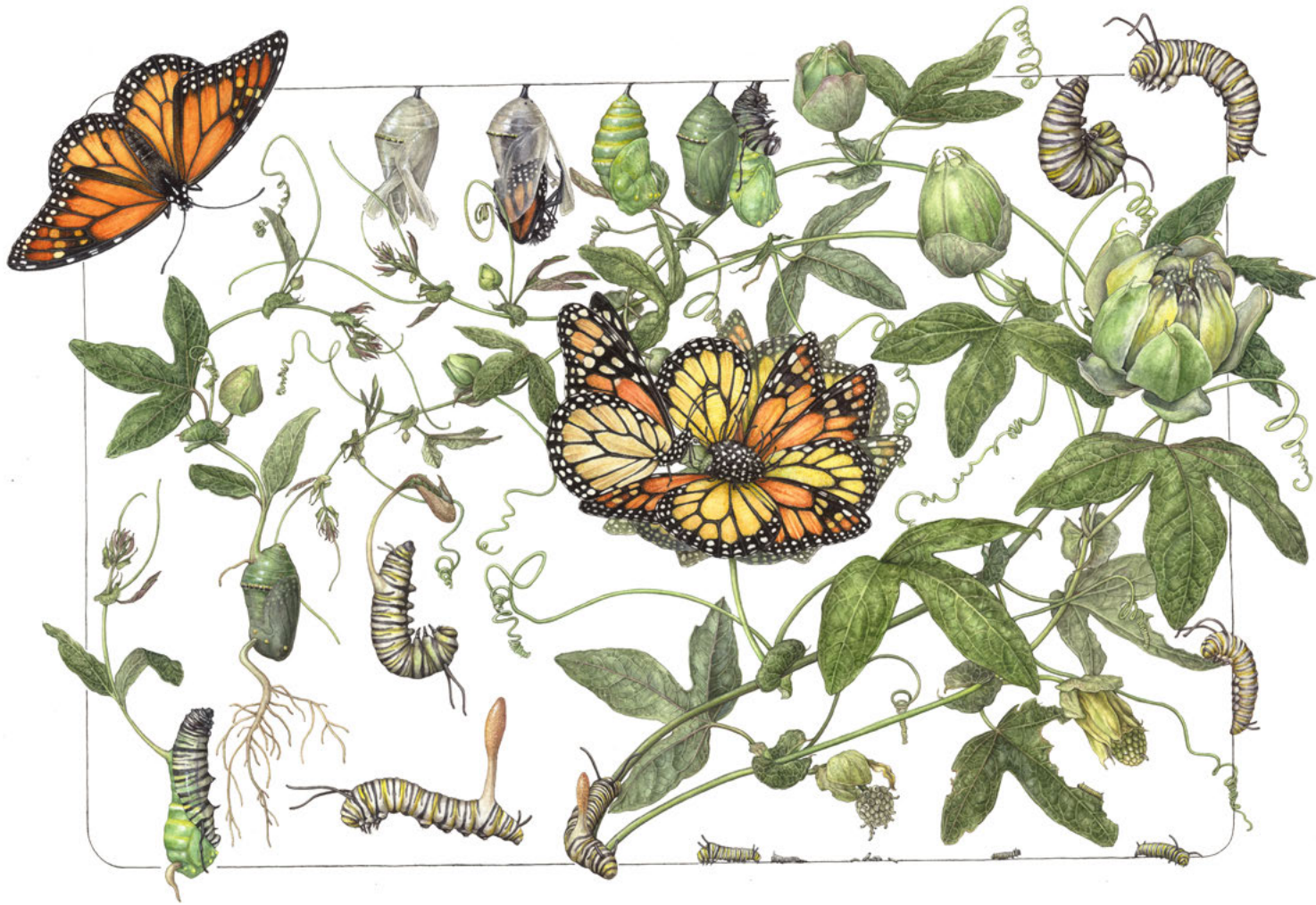
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Bioinfrastructures for Mobility Justice

Columba González-Duarte

Each year, a late-summer monarch butterfly generation migrates across Canada and the United States to Mexico. To complete this migration, they live six times longer than their parents and spend months in semi-hibernation waiting for their host plant, milkweed, to reappear in the spring. With its longevity and remarkable geographic reach, the monarch inspires and challenges all three North American governments' biodiversity and mobility policies. As part of conservation efforts to keep this at-risk migration alive, the butterfly's host plant is increasingly qualified as a bioinfrastructure that provides shelter to monarchs and offers ecosystem services to humans.

Thinking-with this butterfly-milkweed intertwining, I propose seeing milkweed as a bioinfrastructure that has the potential to enable justice for humans and monarchs migrating throughout North America. To make this argument, I am also inspired by how Asuka Hishiki depicts the plant-butterfly relation in the illustration below. Challenging the boundaries of what constitutes a host-guest relationship, Hishiki – a botanical artist and monarch lover – captures the fact that a monarch butterfly's lifecycle is also a plant's. In response to this collection's provocation, I challenge the view of bioinfrastructures being seen simply in terms of their ecosystem services to consider them as enablers of a broader and much-needed path to mobility justice.



Monarchs cannot survive without milkweed, but in many places milkweed struggles to survive without appreciation and care from humans. The evolutionary relationship of a plant being eaten by an insect is described in scientific and popular literature as an ‘arms race,’ a competition in which the milkweed gradually poisons the monarch caterpillar to avoid total defoliation (Agrawal 2017: 22–42). In a different angle on plant–insect communication, Carla Hustak and Natasha Myers (2012) mobilize Darwin’s, Margulis’s and Haraway’s work on evolution to offer a feminist reading of interspecies communication. In their words: “Plant bodies are extensive, distributed, and entangling” (2012: 81). Plants create affective entanglements with their human and more-than-human visitors. Although, at first glance, humans do not seem organically intertwined with the monarch–milkweed exchange, what if milkweed can entangle not just monarchs but also the humans who move in similar ways to this butterfly?

Monarch Butterfly Type B Metamorphosis.

©Asuka Hishiki, 2013, rights granted for this publication only.

Multispecies Mobility Justice

Framing justice in terms of mobility pushes beyond traditional Western justice frameworks which presuppose isolated and sedentary individuals (Sheller 2018: 45). An ontology of mobility justice, by contrast, stresses how sites and agencies are intertwined. A city, for example, is not just made up of the actors or activities stationed within its boundaries but comes to exist, too, through processes and relations that occur beyond its borders—through telecoupled geographies, that are often mediated by unequal power dynamics (Chester et al. 2022: 2). Extending this perspective, agencies of different origin – plants, animals, humans – are also engaged in co-productive relations. As will be explained below, in this case the butterfly's ability to live depends on human actions and human connections to its host plant. Nurturing these co-productive and telecoupled, or distantly connected relations requires a more expansive and dynamic conception of justice.

According to Mimi Sheller, “(im)mobility creates (in)justice” (2018: 30). In Sheller's intersectional view on the politics of movement, movement is constrained or enabled by one's class, gender, race, citizenship and ability. Moreover, (im)mobility is a matter of taxonomic classification: the usual hierarchical ordering of species in which humans are served first also enables or halts animal mobility (White and Sulek 2022). Infrastructures designed with human mobility in mind can consequently facilitate (Greatrex 2022: 53) or halt (Roos 2022) animal mobility – an issue crucial for migratory species that need interconnected habitat.

Milkweed as an urban bioinfrastructure is capable of fostering mobility justice precisely because it merges different scales of mobility with and beyond the city. Let me elaborate by looking at Hishiki's artwork again. We see a flower made of monarch wings offering nectar to its insect pollinators. A bulb-like structure with dangling roots is depicted as something we might call a bulb-root-chrysalis, the chrysalis being the protective covering of a butterfly pupa. This bulb-root-chrysalis is imagined as an in-between metamorphic organism; it is connected not only with the insect but with other butterfly-plant knots. Together, they form a single codependent organism. Challenging the language of conflict and competition in guest-host relationships, Hishiki invites us to see monarchs as a host insect to the weed. This slippery intertwining of who hosts who is also apparent in milkweed's occupation of urban areas as monarch enthusiasts and city planners plant it to help the monarch migration. This tending of milkweed raises the question: what if we shift the focus to it being a plant hosting humans through its interspecies relations with the iconic butterfly?

Milkweed has slowly gained attention from urban planners and conservationists who see it as the perfect bioinfrastructure for restoring pollinator habitat in North American urban spaces, given people's growing interest in the monarch (Johnston et al. 2019). Recent studies propose that nature, and monarchs in particular, require cities (Derby Lewis et al. 2019). The argument is twofold. First, agribusiness's negative impact on rural ecosystems through chemical fertilizers, pesticides and herbicides is so drastic that cities are potentially less deadly spaces – especially for migratory species like monarchs which require continuous healthy habitat. Nature also needs the city, in this view, because urban dwellers care for it. Monarchs appear within this conservation

literature as the perfect conveners, inspiring people to turn urban spaces into pollinator habitats. Scientists (Johnston et al. 2019) have estimated that the milkweed rewilding of important US cities within the monarch's breeding range, like Kansas City, Chicago and Austin, can save the monarch migration while providing nature-based infrastructures to urban communities.

There are diverse human actors who, despite having different degrees of access to mobility justice, are intertwined with milkweed rewilding. It was late summer on the occasion of the Twin Cities Monarch Festival¹, which celebrates the butterfly's fall migration and the Minnesota–Mexico connection. This binational nature-culture festival is organized by amateur monarch enthusiasts and activists who stress the importance of interconnected mobilities. Mobilizing heritage and indigeneity, they invite us to reimagine what justice can look like. Larry, one of the people behind this event, expressed his desire to raise awareness of how mobility always affects life. He explained this relationship through the metaphor of a river: as the Mississippi connects distant cities, the monarch unites us across remote and unequal geographies. This is why Larry and other activists designed the festival to spread information about the use of herbicides in the Corn Belt region. Agribusiness corn production kills the monarch's host plant and disrupts people's relationships with native corn. Hence, during the festival, organizers distribute milkweed seeds and seedlings for visitors to plant and recreate monarch habitat in their own gardens. Participants can learn about the benefits of native corn cultivars, which require fewer herbicides that suppress milkweed.

¹ The Twin Cities are St Paul and Minneapolis in the state of Minnesota.

Aztec dance performance at the binational Twin Cities Monarch Festival.
Photo: Columba González-Duarte, 2015.



The festival also celebrates the Mexican diaspora's contributions to the Twin Cities. It draws attention to the labor that Mexican residents provide – often under harsh conditions – and the rich heritage they bring to US cities. Mainly first- or second-generation immigrants, the Mexican festival organizers and participants claim their right to move across borders. At the festival, they express this through dances linking their heritage to Aztlan – the Aztecs' original homeland – and to the monarch's supranational mobility.

Being in contact with milkweed helps people to understand the shared injustices that monarchs and humans in movement face. I am mindful that not every monarch enthusiast who plants milkweed will make this connection, nor will every milkweed patch that regreens cities and aids pollinators also eventually help other humans in movement like those who attend the monarch festival. Deeply entrenched structural and ontological-political barriers lead people to disregard the intertwined causes of human and animal immobility. However, it is clear that the powerful pairing of milkweed and monarchs can inspire awareness in support of more-than-human justice.

One can only applaud any urban planning and conservation attempt to make cities more welcoming to animals on the move. But I posit that urban greening efforts will thrive only once they foster mobility justice for humans, plants and animals. A city mindful of multispecies mobility justice is one courageous enough to challenge the ongoing structures that reserve justice for some beings only. Such cities nurture the assembled and caring agencies sustaining all those in movement. Just as Hishiki's art encourages us to reimagine plant/insect boundaries and the monarch butterfly festival celebrates socioecological bonds beyond borders, I invite us to re-envision justice for all who move across distant yet interconnected geographies.

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2013 *Monarch Butterfly Type B Metamorphosis* © [Asuka Hishiki](#). This piece was created while the artist lived in NYC. It is one of a series representing Hishiki’s engagements with monarchs and milkweed over the course of more than a decade. A digital copy has been generously shared for this publication only and with no commercial purposes. To learn more about Hishiki’s work, visit <http://greenasas.com/artist-statement/>.

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