Introduction

Earthquakes are inherently local events. Rock masses shift in a specific location along a geological fault, sending seismic waves that can damage the built environment. And, when they occur near a major city, mass casualties sometimes result. Many of the most devastating earthquakes in world history, although not necessarily the most fatal, were those that have wrecked large metropolitan areas: San Francisco in 1906; Tokyo-Yokohama in 1923; Ashgabat, Turkmenistan, in 1948; Managua, Nicaragua, in 1972; Tangshan, China, in 1976; Mexico City in 1985; Kobe, Japan, in 1995; Port-au-Prince, Haiti, in 2010. Scholars of urban earthquakes tend to employ local and national registers to trace their destruction and impacts, as well as the process of rebuilding. They follow building codes and local planning, the class and racial disparities of earthquake damage, and grass-roots mobilization. Sometimes, major earthquakes are interpreted as watershed moments in national politics: for example, earthquakes in San Juan, Argentina, in 1944, Managua 1972, and Mexico City 1985 empowered popular move-ments and civil societies vis-à-vis authoritarian states (Buchenau and Johnson 2009; Healey 2011; Rodgers 2013).

Rarely are earthquakes, given their place-specific dynamics, understood in global-historical frameworks of connectivity and convergence. What would a global history of an urban earthquake look like? We might consider the global formation of earthquake science and earthquake-ready building codes or the global expertise driving rebuilding efforts, especially in cities throughout the Global South in the twentieth century (Coen 2013). We might explore the global dimensions of race- and class-based tensions – for example, the movement of people, animals, and diseases that stigmatized some peoples and neighborhoods as less worthy of reconstruction, or worse, as fit for removal. The 1906 San Francisco earthquake and fire, as historian Joanna Dyl (2017) has asserted, cannot be understood outside urban Chinese migrant subsistence practices and the racialized stigmas of Chinatown that the bubonic plague outbreak had reinforced among the urban elite several years before the quake. Certainly not all earthquakes have equally global dimensions; historical epoch matters. The first "global quake" may have been the Lisbon earthquake-tsunami-fire of 1755. It sparked perhaps the first internationally coordinated relief effort, and accord-ing to one historian, changed the course of the European Enlightenment (Molesky 2015). However, one might say that the nineteenth century inaugur-ated the era of the globalized quake when urban planning and development practice spread widely, the movement of people and the companion species (including diseases) they brought with them accelerated, global markets formed, and racist colonial ideologies circulated across diverse urban centers.

The way historians tend to study urban earthquakes mirrors the way urban environmental history writ large has taken shape over the past several decades. Urban historians often study nature in the city, circumscribed by the city's limits – what urban political ecologists David Wachsmuth and Hillary Angelo (2015) call "methodological cityism." Even when historians expand their spatial scale, they remain bound, generally, to the immediate hinterlands or the region, exploring topics such as suburbanization, capital flows, or "urban metabolisms" – the energy, water, waste, foods, as well as other material inputs and outputs, that flow between cities and wider metropolitan hinterlands (Cronon 1991; Rome 2001; Dagenais and Castonguay 2011; Needham 2014; Sellers 2015; Vitz 2018; Kim 2019). The emphases on place-making; the workings of local ecological processes; the peculiarities of municipal governance; and the concentrations of peoples who must be governed and provisioned – and who in turn make political claims to improve their lives – explain these more narrow geographical scales. The result has been a long list of city biographies and metropolitan histories, in addition to a smaller list of comparative histories that analyze environmental processes in two or more cities undergoing a similar transformation, such as industrialization (Platt 2005).

"Globalizing Urban Environmental History" is predicated on the notion that global patterns and connections have created what on the surface appear to be highly localized and specific urban environments. And, in turn, seemingly disconnected and localized urban-environmental conditions and processes help shape global history. By simultaneously zooming in on the idiosyncrasies of local urban ecologies and zooming out to discern connections, I outline what a global urban environmental history can look like. In this Element, I will argue that a global lens fixed on the material, political, and cultural flows, movements, and connections made possible by capitalist expansion and empire sheds new light on the histories of specific urban-political ecologies, on the one hand, and the large-scale material-ecological and political forces that produce wider urban patterns on the other. These patterns comprise shared urban-environmental imaginaries, strategies of environmental governance, and a global urban landscape stitched together by the adoption of fossil fuels.

Global history has reshaped the fields of urban and architectural history whose practitioners had cast their lens beyond the local urban form only superficially. When such historians studied the cities of the Global South, their conclusions were often implicitly comparative with a normative Euro-American model that revealed their urban sites as "lacking" in some important characteristic – legality, planning, industry, civil society, and so on – that European or North American metropolises had supposedly attained (Davis 2005; Robinson 2006; McFarlane 2010). They followed, in effect, the script

of modernization theory whereby cities throughout the Global South were to be evaluated based on their "stages of development," a theory that derived from nineteenth-century colonialist ideology. Global urban historians, however, reject these approaches that stress urban difference and relegate non-Western cities to an inferior status. Instead, they draw on recent historical studies that highlight the mutual construction of European (metropolitan) and colonized spaces and cultures in order to delve more deeply into the variegated histories of "globalization." No one global urban history employs the same method; different geographic scopes and varied emphases on local, regional, and global spatial registers abound. The unifying thread of global urban history, however, is the study of the connective tissues that bind cities together: planning and architectural ideas; transnational urban political struggles and cultural movements; and the flows of materials, micro-organisms, commodities, finances, and people. In these histories, expanding the geographical scope of analysis reveals otherwise occluded patterns and connections that themselves become the subjects of study, the global phenomena that make and remake cities (Echenberg 2007; Nightingale 2012; Goebel 2015; Kwak 2015; Kenny and Madgin 2016; Sandoval Strausz and Kwak 2018). In other words, by zooming out to a global perspective and pinpointing causative global forces, urban historians explain more fully the histories of individual cities and groups of cities (Nightingale 2016). In this approach, cities become nodes of contact where the "local" and the "global" interact not as binaries but as co-constitutive forces (Tsing 2005; Sugrue 2018).

Apart from a number of histories of public health and medicine that follow epidemics across urban spaces, the nonhuman environmental realm rarely figures in this broader field of global urban history. Meanwhile, as previously mentioned, much urban-environmental history scholarship since the 1980s remains stuck in the particularities of local urban ecosystems, that is, of singularity and difference. This Element melds the methodological prescriptions of global urban history, the innovative methods of environmental history, and the interdisciplinary field of urban political ecology to trace the contours of a global urban environmental history. To do this, I identify connectivity, convergence, and divergence and center the historical agency of the nonhuman world, activated within particular urban practices and formations – global and otherwise (Nash 2005; Latour 2005; Bennett 2010; Walker 2011). The human and nonhuman realms of a city intertwine to create the urban ecology, or the urban environment, terms I use interchangeably. And I define these terms capaciously as the built environment and the urban technical networks that carry natural elements (water and energy, for example) in and out of cities; the labor activities that literally produce "nature" in cities; the plants, animals, micro-organisms, and biophysical processes within urban spaces; and the cultural imaginaries that represent urban nature.

Concepts and Method for a New Global Urban Environmental History

The sections that follow draw on decades of scholarship on political ecology, cities, and global history. Throughout I will employ several key methods and concepts from this literature that enrich our interpretation of historical urban ecologies as global phenomena. My objective here is to define and establish a clear and common understanding of them and show why they are useful for our purposes.

My approach to global urban history is grounded in the large-scale structural integration of the globe through two intertwined historical forces that ramped up in the nineteenth century: capitalism and imperialism. Capitalists increasingly relied on their state's territorial (colonial) expansion to extract and commercialize mineral and other resources and appropriate land to sustain their profits and thus sustain the capitalist system's inherent growth logic. European and North American imperial actors, in turn, justified territorial expansion and rule over foreign peoples through racist ideologies such as "the civilizing mission," "white man's burden," and other ideas that posited Native inferiority and European (and Euro-descendent) superiority. Working together, commercial and industrial capitalism and European and US-American imperialism linked urban political, cultural, and physical forms in new ways, producing simultaneously a convergence and a divergence of experiences. Scientific and planning ideas and the flows and movements of people, organisms, diseases, and commodities operated within these asymmetrical structural forces of integration. Meanwhile, nation-state consolidation across Western Europe, Latin America, and parts of East Asia, as well as nationalist movements across the colonized world – all of which were structurally interconnected through global ideologies of liberal capitalism and later Marxism – also frame the comparisons and connections I trace in this Element. Borrowing from Sebastian Conrad (2015), it is the structural integration of urban spaces across national and imperial borders that gives the flows and exchanges global historians like to study their causal force. This globalizing process of the urban form is the foundation of this Element. My emphasis on global structural integration, however, does not imply Eurocentric diffusionism. Instead, I underscore mutual interaction, exchange, and the synchronicity of urban change wherein multiple urban experiences, the global reverberations of local encounters, and large-scale patterns beyond a single nation are better comprehended.

In the Western imagination, cities have been understood as anti-nature, either artificial stains on a pristine nature or a bucolic countryside, or, more often, metonyms of technological prowess and progress that subjugates nature. Starting in the early twentieth century, urban ecologists and some environmentally minded

planners began to explore the importance of nature in cities, as a set of elements to be properly governed, regulated, and cultivated to foster urban growth and preserve health. This thinking has culminated in ecological modernization prescriptions such as "green growth" and "smart cities" that dominate environmental planning today. However, several decades of scholarship by urban geographers and urban-environmental historians have countered this "apolitical urban ecology" that separates nature from social power and capitalist production. Their critical interrogation of urban ecologies has revolved around infrastructural politics, power relations, class and other forms of social conflict, and urban-environmental imaginaries (Gandy 2002; Heynen, Kaika, and Swyngedouw 2006; Heynen 2014; Heynen 2016; Simpson and Bagelman 2018; Cornea, Véron, and Zimmer 2017). Moreover, some of these studies transcend the confines of city boundaries to include the metropolitan, regional, or hinterland ecologies that become entangled in the process of urbanization – the infrastructural planning of cities, cultural representations and what urban political ecologists call, the "urban metabolism" (Swyngedouw 2004; Delgado Ramos 2015; Schmidt 2017; Coplen 2018)

Neil Brenner and Christian Schmid, who adopt Henri Lefebvre's understanding of a late twentieth-century "urban revolution," extend the urban metabolism metaphor. They contend that we are undergoing a period of "planetary urbanization" in which the whole world, even spaces long considered "rural," are becoming essentially urban because of their industrialized extractive systems of production and technical infrastructures (Lefebvre 2003; Brenner 2014). While urbanization has been an extraordinary social phenomenon across all six inhabited continents, it hardly makes sense to view all spaces enwrapped in urban metabolisms as themselves "urban." Alternatively, historian Chris Otter (2017) proposes that urban researchers employ the term "global technosphere" to denote these diverse built environments that are created through urbanization but whose social relations, politics, and culture are not reducible to it or defined exclusively by it. This global technosphere, I argue in Section 2, was made possible by the global energy transition from solar (water, wood, wind, muscle) to fossil energy, particularly the multiple uses of petroleum and the ease of its transport. Petroleum, as the lifeblood of a global energy metabolism, has allowed empires, nation-states, and capitalists to create new and interconnected urban spaces. I thus borrow Otter's ideas of globalized technical systems to explore the political, economic, cultural, and physical manifestations of an urban world made of and through petroleum, or what one urban scholar has called the "global urban petroleumscape" (Hein 2018).

This Element is not purely a top-down history of political and economic elites and technical experts (planners, public health officials, investors, and engineers) devising environmental governance strategies and large technical systems.

I remain attentive to the genealogies of popular resistance, citizenship claims and the obstacles to achieving them, and worker organizing. These often highly particular practices, while stemming from global patterns of environmental governance and energy metabolisms, cause variations across urban spaces. Thus, a global urban environmental history must simultaneously attend to the synchronous and patterned urban transformations made possible by colonial capitalist expansion, different racist regimes, and nation-state consolidation throughout the nineteenth and twentieth centuries, as well as the local idiosyncrasies that have made diverse urban-political ecologies. It is in this encounter, the frictions of the local and the global, that allow us to bring into sharper relief both the environmental histories of individual cities and the global patterns and connections that have made those cities what they are.

In sum, I make four major conceptual and methodological propositions to support this outline of a global urban environmental history. First, by the early nineteenth century, capitalism and empire, operating in tandem, as well as nation-state formation, enabled the types of flows, connections, and exchanges that bound previously discrete urban environments into a broadly similar historical process. Second, nonhuman nature – from diseases and animals to the energy resources that traverse cities – were constitutive forces of vast landscapes subjected to urbanization and regimes of urban governance enacted at regional and global scales. Third, the specific urban ecologies, the interacting set of social relations, the built environments, and the biophysical systems of a given city, were themselves interconnected. Urban ecologies tend to be studied in isolation, yet their historical dynamism is incomprehensible outside global circuits of ideas, people, and nonhuman nature such as diseases and resources situated within systems of production (both capitalist and socialist) and empires. In order to trace these connections, I position urban environmental history within histories of public health and the theoretical contributions of political ecology that understand urban metabolisms – the flows of materials and energy in and out of cities – across multiple spatial scales. I also track the technical experts who have reordered and tailored urban spaces and harnessed urban nature for human habitation. While the particularities of their interventions are unique to each city with their varying ecosystems, cultural tendencies, and state structures, the flow of ideas within circuits of empire helped generate the widespread political and cultural power of the urban expert. Fourth, the large-scale adoption of fossil fuels freed urban metabolisms of their regional boundaries. By the early twentieth century, fossil fuels, especially petroleum, not only made urban life tick but also linked cities together and cities to vast energy hinterlands, forming a global urban petroleumscape with immense political, ecological, and cultural consequences. In the conclusion, I address

the challenges and opportunities this petroleumscape presents for the building of a decarbonized urban world in an age of climate destabilization.

1 Disease, Power, and the City: Global Urban Ecological Formations in the Age of Empire

During what historical epoch does it become meaningful to study urban environments as globally interconnected? Certainly, global connectivity did not emerge abruptly. There was no sudden switch that unleashed connections across oceans and administrative boundaries, nothing that demarcated a clear temporal boundary between a "before" and "after" globalization. Pre-modern and medieval historians have traced the "sporadic bursts" of spatial connectivity across empires and kingdoms, as well as the periods of recession and decompressions that disconnected cultures (Reinhard 2015). The spread of Islam in the medieval period created the conditions for the transfer of certain agricultural and irrigation techniques between the Middle East, Africa, and parts of Europe (Mikhail 2017). Trade between Europe and East Asia, in which the Middle East served as a conduit, also moved rodents across the Eurasian continent, transporting the bubonic plague that scourged Asian and European cities in the fourteenth century (Abu-Lughod 1991; Crossley 2008; Gitlin and Arenson 2013; Harrison 2013). A few exceptions notwithstanding, such wide-scaled spatial connections and exchanges tended to be concentrated in frontier zones, the interstices of empires. And, due to technological limitations in seafaring, those connections were rarely truly globe-trotting (Reinhard 2015). However, once seafaring technology, impelled by European commercial interests, improved, global urban-environmental connectivity intensified – first across the Atlantic. Spanish officials in New Spain, for example, brought European ideas about water management to Mexico City, with the purpose of draining the lake on which the city was built to protect urban properties and reclaim land for farming. This was not a simple story of idea transfer, however; the actual engineering of the urban waterscape in New Spain reflected a fusion of Indigenous and European knowledges and technologies (Candiani 2014). Spanish officials remade more than urban waterscapes. They changed the very foundation of urbanism in their colonial possessions from Manila and Mexico City to Lima by introducing grid road patterns and designing central squares reserved for Spanish settlement while Native peoples were relegated to the peripheries (Kagan 2000). The European settlers of North America, who did not rely on Native labor and governance traditions to support the colonial project, expropriated Indigenous lands outright and more systematically introduced to their towns and cities Europe's "portmanteau biota" (the term Alfred Crosby (2004) gives to the species Europeans brought with them). Wherever they went, Europeans sought to

tailor their new urban sites to what they were familiar with back in Europe –
their built environment and the plants and animals they used for transport and
sustenance (Cronon 1983; Cleary 1997; Crosby 2004; Klingle 2007; Simpson
2022). On the other side of the Atlantic, Ottoman trade linked Cairo's ecosys-
tem – its plants, animals, and micro-organisms – to a larger Mediterranean
world (Mikhail 2012). Ocean-traversing empires of the seventeenth and
eighteenth centuries generated new global connections that reshaped urban
environments and spatial governance.

Urban-environmental connectivity intensified further starting in the early nine-
teenth century because of coal-fired capitalist industrialization and another burst
of European imperialism in Asia and Africa. Textile manufacturing, increasingly
powered by coal, spurred colonial trade in raw cotton, finished textiles, sugar, tea,
and other commodities linking port cities and other entrepots such as Bombay,
Madras, Calcutta, Hong Kong, Manila, Singapore, Hanoi, Havana, and New
Orleans to metropolitan hubs like Liverpool, New York, Le Havre, and
London. This trade between urban nodes fostered the biological integration of
the globe. Diseases such as the bubonic plague, cholera, and yellow fever
transmitted through either human contact or animal vectors, moved readily
from port to port on board commercial (and military) ships.

Commerce created broadly similar levels of urban density across imperial
port cities. Large numbers of workers settled in closely packed quarters near the
warehouses and docks that harbored disease. By the 1830s, Liverpool's harbor
teemed with ships, while workers – mostly Irish – toiled onshore loading and
unloading bales of cotton between ship, warehouse, and train for a miserly wage
(Beckert 2014). Similarly, in cities such as Bombay, Hong Kong, and Hanoi,
a floating population of rural migrants seeking work in the bustling colonial
ports lived in cramped, service-deficient, and substandard housing adjacent to
port infrastructure.

For the *Aedes aegypti* mosquito, the vector of yellow fever, the warmth and
humidity of commercial ships carrying sugar, and their ample supplies of fresh
water, made for ideal long-distant vehicles for disease transmission, even
occasionally into temperate cities like Philadelphia. Urban construction sites
and docks, as well as warehouses full of barrels and other containers where
rainwater accumulated, also made for ideal breeding grounds. And, as the sugar
economy brought thousands of potentially unimmune merchants, enslaved
workers, and soldiers to these ports, mosquitoes had ample means to spread
the virus, known as "sailor's disease" throughout the French West Indies and as
"black vomit" in the Hispanic Caribbean. "Ships, in effect were super-vectors,"
writes J.R. McNeill, and "ports . . . were super-hosts, providing warm welcomes
for mosquito and virus alike" (McNeil 2010: 51–2). The same could be said of

the plague-carrying fleas of the Norway rat, which found abundant habitat aboard ships crossing seas and oceans and in warehouses, and which easily jumped to the rat populations of adjacent worker neighborhoods (Echenberg 2007; Chhabria 2019; Webster 2021). The bacteria *Vibrio cholerae* (cholera), mostly dormant prior to the densification of colonial urban life, proliferated in the fast-growing slums of British India, and trade infrastructure brought the disease to Britain in 1831 where it tore through Liverpool's poorly serviced slums (Gill, Burrell, and Brown 2001). Colonial commerce and its unintentional companions, port infrastructures, as well as the growing urban congestion associated with trans-imperial trade, massively scaled up the global urban-ecological nexus.

Urban environments became not only interconnected biophysical formations but also, because of the rise of shared regimes of modern governance across nation-states and colonial possessions, interconnected sites of regulatory practice and intervention. The urban ecologies that arose through Western colonialism and early industrial capitalism raised a fundamental question of governance among elites: How would states – whether liberal republican, monarchical, or colonial – address the basic infrastructural and biological imperatives of city building? The answers to this urban question, in effect, animated modern state power. A new and empowered technical and scientific elite devised and circulated a set of representations about the relationship between cities and nature and between urban inhabitants and their health in inter-imperial travel, scientific publications, global sanitary conferences, and the intellectual exchanges of municipal governments. Within municipal, national, and colonial administrative units, these experts aimed to mitigate perceived environmental threats and transform urban spaces under the civilizing impulse that gripped nineteenth-century elites. They were charged with controlling, channeling, and tapping water; separating "bad" from "good" water; managing diseased environments and, later, diseased bodies; and controlling urban spaces deemed unruly and unhealthy through technical interventions and surveillance, marginalizing, in the process, opposing views of insalubrity. Urban environments were deemed increasingly knowable and governable, subjected to a strikingly portable set of interventions by government officials and technical experts. I call these shared representations, borne within the dual and intersecting process of imperial expansion and nation-state formation, the global urban-environmental imaginary. And, their repertoire of interventions – drainage and sanitary infrastructure, public health interventions, segregation, and urban forestry – stemmed from this environmental imaginary.

By placing in conversation a wide range of histories of nineteenth- and early twentieth-century public health, medicine, and cities and considering patterns