If the Past Teaches, What Does the Future Learn?

Ancient Urban Regions and the Durable Future

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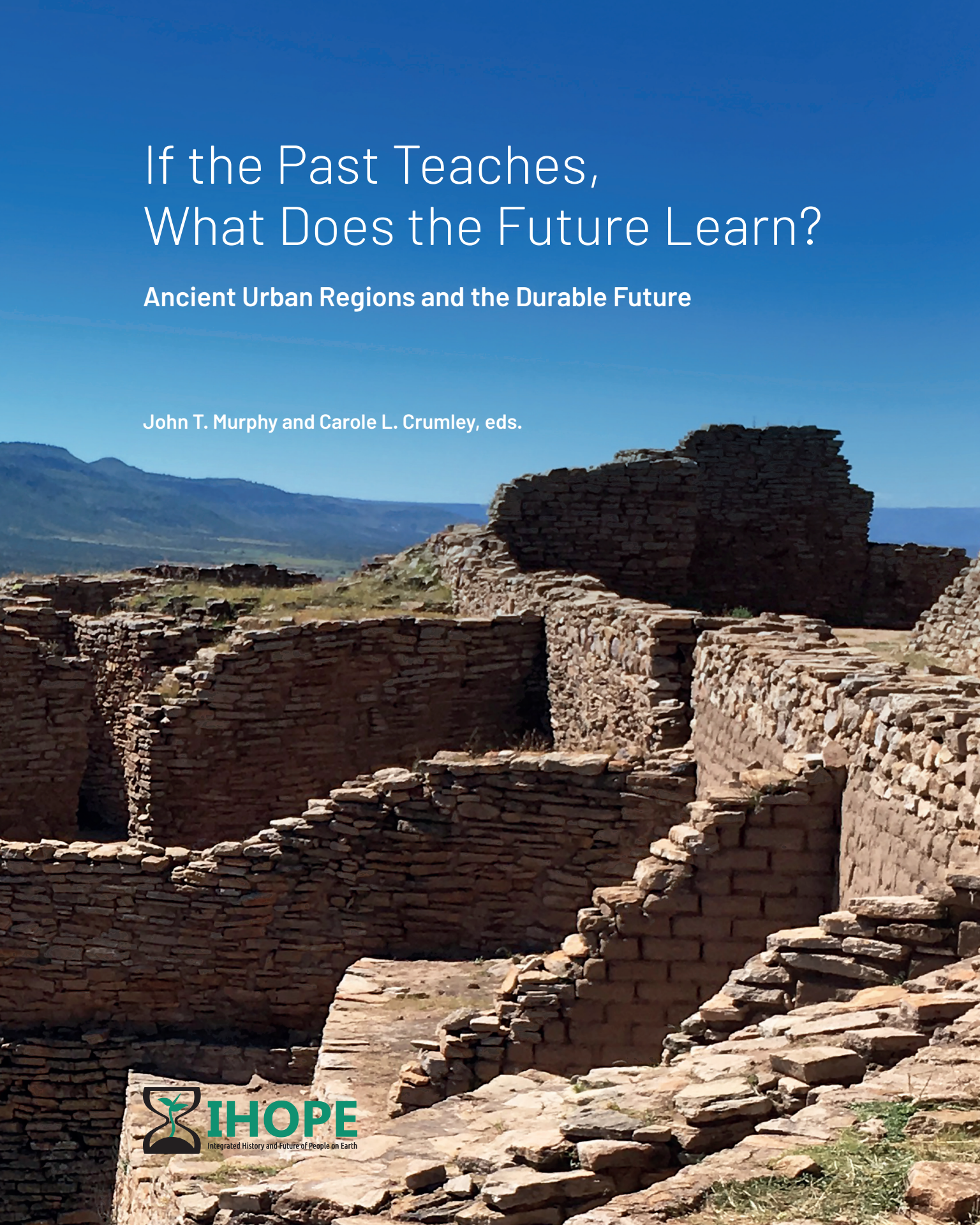

IHOPE
Integrated History and Future of People on Earth

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Colophon

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Panorama view from the urban core at La Quemada dating to ca. 500-1000 CE and located in central Zacatecas, Mexico. Site restoration 1986-2006 by Peter F. Jimenez (Instituto Nacional de Antropología e Historia, Mexico). Photo by Christian Isendahl.

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IHOPE

Integrated History and Future of People on Earth

Preface

This project was begun in late 2017, when the Integrated History and Future of People on Earth (IHOPE) launched a study of the role archaeology could play in the conceptualization and realization of the cities of the future. Our project was funded by the US National Science Foundation's National Socio-Environmental Synthesis Center (SESYNC) in Maryland, USA, which brings together research groups that merge the science of the natural world with the science of human behavior and decision-making, in order to find solutions to environmental problems.

IHOPE was awarded three workshops, which were held at SESYNC in Annapolis in the autumn of 2018 and in the spring and autumn of 2019. Participants are practitioners of archaeology, history, ecology, regional planning, and of urban, regional, and landscape architecture. Our goal is to demonstrate to future planners and designers the utility of the study of ancient cities and their regions.

Using two initial proof-of-concept cases (cities of the ancient Maya in the Yucatan Peninsula and early urban Mesopotamia), the first workshop produced the research design and identified the necessary data to be obtained from case studies. Participants were Arlen F. Chase, Joel Gunn, George Hambrecht, Emily Hammer, Lisa J. Lucero, John T. Murphy, Jennifer R. Pournelle, Vernon L. Scarborough, Norman Yoffee, Qiong Zhang, and the Principal Investigators, Carole L. Crumley, Carrie Hritz, and Christian Isendahl.

The second workshop explored and tested the research design from a wider perspective, and included specialists working in Africa, North and South America, Europe, and Asia. In addition to the PIs, participants were Andrew J. Dugmore, Shirley J. Fiske, George Hambrecht, Michael Heckenberger, Thomas H. McGovern, John Meunier, Lee Mordechai, John T. Murphy, Theresa Ong, Payam Ostovar, Clemens Reichel, Marcy Rockman, Vernon L. Scarborough, Paul Sinclair, Miriam Stark, and Federica Sulas.

The final workshop added two new case regions (Aksum in Ethiopia and Atlantic Europe) and began the writing process. Participants in the final workshop, in addition to the PIs, were Lisa J. Lucero, John Meunier, John T. Murphy, Steffen Nijhuis, Payam Ostovar, Vernon L. Scarborough, Federica Sulas, and T. L. Thurston. While this group wrote the final text (with additional input from Clemens Reichel), they are nonetheless deeply indebted to the participants in Workshops I and II, whose ideas, suggestions, and critiques were central to the form the project has taken. With important input from colleagues from the previous workshops and from the wider academic community, editing and organization of the manuscript was led by John T. Murphy with the assistance of Carole L. Crumley and copyediting by Christian Isendahl and Chris Potter. Steffen Nijhuis was instrumental in preparing the manuscript for publication and guiding the work to completion. We also gratefully acknowledge Nienke Blaauw for preparing the book's design and layout.

The views expressed herein are those of the authors and do not necessarily reflect the views of their employers, funders, or affiliated institutions.

Our work includes numerous images provided by courtesy of the original creators or current copyright holders. Uncredited chapter headings for Chapter 1 (waterfront, Chicago, USA) and Chapter 7 (urban farming in Havana, Cuba) courtesy of John T. Murphy and Christian Isendahl, respectively. Image for Chapter 8 (view of Chicago and surrounding area at night from the International Space Station on 2 February 2012) courtesy of the Earth Science and Remote Sensing Unit, NASA Johnson Space Center (NASA PhotoID: ISS030-E-62540) available at https://eol.jsc.nasa.gov/. Timelines for the headings of Chapters 2–6 created by Véro Crickx.

We wish to express our thanks to the US National Science Foundation for support for this project, and to the National Socio-Environmental Synthesis Center (SESYNC) and its staff for three smooth and pleasant sojourns on their campus in Annapolis.

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Contents

1 – Introduction

For at least six thousand years cities have been centers of transportation, trade and exchange, production, consumption, government, religion, healthcare, the arts, entertainment, education, research, and waste generation. Because all cities need access to food and water, many well-established cities are found on rivers and near coasts, sprawling over some of the world's most fertile agricultural soils (Bren d'Amour et al., 2017). Now with an impermeable veneer of concrete, they are under threat from increased flooding and rising sea levels. Today's cities, often built with insufficient siting and planning and profligate use of energy and matter, cannot subsist solely on their regions' resources and are thus dependent on long, expensive, and increasingly vulnerable supply chains (Rood et al., 2004).

FIG. 1.1 Chapultepec Park in Mexico City. Image by Bohao Zhao, CC-BY-3.0, https://creativecommons.org/licenses/by/3.0, via Wikimedia Commons.

How can we transform urban environments to encourage durability and mediate the social price of myriad risks and vulnerability? There is now little time to experiment with novel urban forms (Linden, 2019; USGCRP, 2018); we must draw from as many cases and models as possible. Many of the world's cities endured for centuries and even millennia despite many constraints and great environmental and social change. While societies in the distant past may appear to be very different from the present, many of today's urban challenges (e.g., food security, bodily comfort, places for social interaction) are fundamentally timeless (Isendahl & Barthel, 2018).

The record of the past offers a laboratory filled with completed experiments in urban design, management, and process. Scholars of human history—archaeologists, historians, and environmental scientists—have the data and tools to observe how cities and regions have changed at different temporal and spatial scales, in response to both external variables such as environmental change, and to internal dynamics such as growing socio-economic inequality and changing socio-political systems. Tools to study the past can detect social and political forms, their variability, and long-term trends; analyze both managers' efforts and individual strategies to mitigate resources and minimize damage; detail the medium- and long-term tradeoffs involved in choosing one strategy over another; illuminate unintended consequences of human behavior; and map the ebb and flow of population, energy, and resources between urban and rural settings and their reconfiguration as conditions change.

We acknowledge that research in this volume does not examine all the factors that have, then and now, influenced circumstances, decisions, and outcomes. Nonetheless, we hope that our initial efforts to address fundamental issues that face every society—water and food security—will inspire others to examine change over time in other political, social, and economic domains, such as quality of life, social categories and identities, or religion and spirituality, among others.

Our work here is to build a bridge from archaeology to mainstream architectural and design theory. The study of places, landscapes, and regions links the two fields. Architecture can be shaped and enhanced by the long-term cultural and geographic perspective afforded by archaeology; architecture can offer archaeology a ride into the future. We hope that our efforts are novel enough to be inspiring and connected enough to allow existing concepts to be furthered.

The bridge unites three domains: material, social, and aesthetic. We look to the past to find material technologies—new engineering and conceptual solutions to an array of problems—and the past obliges with many examples. However, these technologies in their material aspects are only part of the story. The archaeologist sees them as playing a role in a system. This system, while mechanically functional, is also profoundly social: it includes administrative structures, but also innumerable other kinds of relationships—kin groups, neighborhoods, genders—that mirror the embedded relations between humans and nature. As in architecture, systems include semantics and aesthetics: not only are these forms pleasing to the eye, but they also tell stories of history and place and give identity and meaning to the lives in which they are enmeshed. This multi-functionality and multi-vocality are inherent in past systems.

Much of post-WWII infrastructure is heroic in scale, but it more often than not serves a singular purpose to justify its particular need and value. In the archaeological record, durable urban regions integrate the needs of multiple agencies in the same space and design. Meyer (1997) has pointed out that we need to move beyond dualities such as urban/rural; we contend that our archaeological examples will help push this forward by encouraging designers to find multivalent solutions to complex design challenges, creating solutions that are not just mechanized or passive but that unite the material, the social, and the aesthetic. The durable forms we review here offer some initial examples; the archaeological record holds many more.

In looking to the past, designers are seeking something that is outside of our current way of thinking and yet still uniquely human. Prompted by challenges ranging from mundane and quotidian to catastrophic, communities in the past achieved unique ways of designing for human survival. The result is not just diverse objects and social systems but a possible road map marking successes and failures.

What lessons can we learn from this? While there are many challenges unique to our times, we think there is much to be learned from the past. It is fairly common to find wonderful books that collect ingenious ancient inventions; it is far less common to see a study collecting a long history of lessons learned from cultures adapting to multiple disturbances and disaster events. How can designs of our dwellings, streets, and infrastructure either enhance or inhibit our own response to disasters and disturbances?

Setting our group's exploration apart is the attention to many spatial scales (e.g., of design or management) and considerable time depth. It is our hope that today's designers and policy makers will learn from design examples that that have evolved over time and at different scales, representing both successes and failures. This multi-scalar approach resonates in particular with landscape architecture scholarship that also engages scales from the object to the region, as well as an expanded view that looks beyond "limited binary terms" (Meyer, 1997) to find the reality that sits in between past and present, urban and rural.

FIG. 1.2 Amager Bakke, also known as CopenHill, a power plant in Copenhagen with a skiable hill sloping down the length of the building. Designed by the Bjarke Ingels Group (BIG). Image by Kallerna, CC BY-SA 4.0, https://creativecommons.org/licenses/by-sa/4.0, via Wikimedia Commons.

This perspective is particularly important as we enter a time when disturbance events grow more frequent and intense. There is a great deal to learn from seeing how ancient peoples both succeeded and failed to adapt their thinking and culture in response to times of dramatic change.

We can see small examples of this way of efficient, multivalent design thinking in many contemporary built designs. Mario Schjetnan's Chapultepec Park in Mexico City almost certainly took design cues from the ancient Aztec *chinampas*, making what could have been just a sewage treatment plant into a public park that celebrates the gift of water treatment to the community (Fig. 1.1). The now iconic Copenhagen power plant (designed by the Bjarke Ingels Group) that also serves as a public ski hill and community vista point elevates an installation typically shoved to the urban margins to something beneficial for all (Fig. 1.2). What lessons can we learn from past regional management and multi-purpose design that can teach us to think about our cities in a new way?

In the following sections we introduce new terminology more in keeping with our findings and examine key perspectives that are common to both archaeological and architectural communities. We then introduce and analyze four ancient regions and their cities and explore a few long-lived contemporary cities. In conclusion, we address how durability could be achieved and deployed in extant and future cities.

1.1 – **The *Durable* Urban Region**

We frame our discussion around *durability*, a concept we deliberately introduce in contrast to the more familiar terms "resilience" and "sustainability". The term resilience is often used simply as the ability to withstand a shock without a fundamental change of functions, whereas we intend to examine forms that permit reorganization at diverse scales and contexts, while others remain unchanged. We find some common ground in the framing of the "adaptive cycle" (per Holling, 2001) in a system that reorganizes while maintaining some essential qualities; however, the ecological rather than social grounding of the adaptive cycle does not apply to all the contexts of interest to us, with model assumptions potentially constraining our socio-environmental analyses.

The term sustainability also fails our needs, because it often carries the connotation of "able to be continued indefinitely" (e.g., a "net zero" process that does not deplete a resource) and, to us, does not connote a complex dynamic system that endures diverse challenges. To apply lessons from the past to today's issues, we must keep in mind that most social systems—ancient and contemporary—may potentially have been impacted by climate change, population growth, resource depletion, pestilence, and greed.

Durability, in contrast, is the positive outcome of practices and strategies that were utilized over a period of time. A durable urban system is the result of a long-term process that is characterized by continuous development, accumulation of knowledge, and incremental experimentation and observation. It includes how societies regenerated after episodes of "collapse" or managed the "art of not collapsing".

Our hope is that by studying the trajectories of durable systems that we can see in the archaeological record we can avoid some of this trial-and-error. We believe that if we are attentive, we can pull from the longest chains of knowledge by remembering the lessons from the past.

Working through a series of case studies that span geographies, cultures, social systems, and time periods, we identify common threads that represent various levels of success in past efforts to cope with changing environmental conditions in urban settings. These approaches combine mitigation and adaptation activities (for definitions see World Bank, 2010) that are readying existing cities, give attention to the geographical regions that support cities, and studying how the relationship between cities and their regions/hinterlands/countryside can be improved.

Durability does not, however, last forever. A pair of boots, even with good care, eventually wear out. Durability intentionally introduces the idea that things will not last forever and must be maintained, while simultaneously advocating for investing in the right move that will last longer. For example, an important critique of many post-WWII urban models is that they built massive amounts of infrastructure with no real fiscal plan for how they would be maintained. This resulted in increasingly substandard housing that continued in use. By contrast, the recent, swift construction of large-scale housing for an immigrant population in Europe, often built from reinforced wood (CLT), is intended to serve as housing not only for immediate needs but, going forward, other communities and purposes (European Network for Housing Research (ENHR), n.d.). Our interest is in establishing the characteristics of management strategies that lead to durability. Over the course of several interdisciplinary workshops, we have studied the effects of short-term decision making on long-term durability, including how decisions made by distant policy-makers often ignore thoughtful strategies that have provided "non-declining throughput" (a common definition of sustainability (Daly, 2006)) of key resources (e.g., soil, organic matter, freshwater) over relatively long time-scales. We are beginning to detail which factors build durable systems and which introduce vulnerabilities over the great time scales we are considering, that is, several centuries to millennia.

Two such factors are diversity and flexibility. For long-term societal survival, the archaeological record shows us that *diversity* is key. A recurring strategy found in durable systems includes the *flexibility* that diversity provides. These reinforce one another: while diversity (of resources, strategies, and perspectives) is the basis for wider choices, flexibility is the ability to alter management and governance to better fit the situation. As Maffi (2007, p. 269) asserts, biocultural diversity is "the diversity of life in all its manifestations: biological, cultural, and linguistic—which are interrelated (and possibly coevolved) within a complex socio-ecological adaptive system" (Maffi & Woodley, 2010). Biocultural diversity is the basis for flexible social, political, economic, and other strategies. Diverse and flexible strategies within a socio-ecological system that has some slack— where each key variable need not be "just right" for the system to function— offer risk management that provides vital latitude in the face of external or internal changes.

Many of the long-lasting examples in the archaeological record involved political systems that were dramatically transformed over time, but which overlay a social system that lasted millennia. These underlying systems were diverse and flexible; they were also labor-intensive, and often imbued with a worldview that honored and protected key resources. These systems contrast dramatically with today's practices, for instance our food production system, which relies on widespread clear-cutting, fossil-fuels to meet high energy requirements, the use of chemical fertilizers and pesticides, mono-cropping, and so on. Past practices and management strategies are reservoirs of knowledge that provide viable options for today and can point to alternative strategies for the future.

1.2 – **Recognizing Cities: A Regional View**

Our formulation for studying the past requires several key definitions. Architecture, regional planning, and archaeology share the language of complex adaptive systems (CAS), that is, systems that are not in equilibrium and do not act in a predictable manner (Batty, 2017; Castells, 2010; Sinclair et al., 2018). In this context, complexity relates to a dynamic network of interactions among elements that are not static and where the behavior of the ensemble cannot be predicted by the behavior of the individual components. A CAS has no overarching hierarchy of elements, but rather a complex heterarchy of interacting elements that may sometimes dominate the system, and at other times be subordinate to it (Crumley, 2005). CAS are adaptive in that elements can self-organize in response to changing conditions. They are systems, in that elements form interconnected networks.

Another shared term is region. Greenberg (2002, p. 4) notes that "regions are small enough to permit close familiarity with specific stratigraphic and cultural sequences, and large enough to exhibit a spectrum of social and economic interaction". These considerations build on Butzer's (1982, pp. 63, 230–278) "medium-scale environment" encompassing a range of habitats supporting human settlement. Thus, we take the region to be a relatively flexible, macro-scale spatial division of the Earth's surface. The concept of region, to be meaningful, must be defined both temporally and spatially (Braudel, 1973; Marquardt & Crumley, 1987; Nijhuis, 2013). Its spatial definition is the scale at which, for the observer or researcher, certain features form a recognizably homogeneous unit. In any given period, the importance of certain features turns on both internal regional dynamics and their external relationships (e.g., trade, climate). Through time, one can expect changes in the ranking of certain priorities as conditions are altered and regional boundaries change.

Perhaps the most commonly used term in both architecture and archaeology is landscape. Both disciplines consider landscapes to be complex systems that consist of multiple subsystems (e.g., urban landscapes, farming landscapes), each with their own dynamics and rate of change (Batty, 2017; Nijhuis, 2013; Otto, 2009). One archaeological definition of landscape is the spatial manifestation of the relations between humans and their environment (Marquardt & Crumley, 1987). In addition to the excavation of sites, the goal of archaeological survey and

mapping (e.g., field walking, GIS, LiDAR) is to understand the dialectical relationships between the biogeophysical environment and intentional as well as unintentional human modifications. From the acts of an individual to those of an imperium, the documentation of human activity over broad expanses of terrain yields economic, political, social, and spiritual evidence. In order to study urban metabolism, it is particularly important to capture urban–rural dynamics through cycles of crisis, renovation, and changing population distribution across the landscape. Measures taken to perpetuate current conditions are evaluated, as are the four queries of sustainability (Allen et al., 2003)—Of what? For whom? For how long? At what cost? The last of these gives particular attention to mapping the different kinds of tradeoffs sustainability might entail (Hegmon, 2017), and the consequences of a chosen trajectory, for example, understanding the benefits as well as missed opportunities by following one path over another (Isendahl & Heckbert, 2017).

Architects and landscape architects often define landscape as an area, perceived by people, the character of which is the result of the action and interaction of natural and/or human factors (Council of Europe, 2000). The urban landscape as a system is a constellation of multi-level networks and locations (Doxiadēs, 1968; Otto, 2009). The spatial dimension of networks and locations can be referred to as the space of flows and the space of places (Castells, 2010). The space of flows can be defined as the formal and cultural expression of structures for the (1) provision of food, energy, and fresh water; (2) support for transportation, production, nutrient cycling; (3) social services such as recreation, health, arts; and (4) regulation of climate, floods, and wastewater. The space of places can be defined as the spatial and cultural expression of a locale whose form, function, and meaning are a result of social, ecological, and economic processes (Castells, 2010; Nijhuis & Jauslin, 2015).

However useful it may seem to bound, or close, a system for purposes of studying it, all cultural and environmental systems are in fact open to events and decisions at a variety of scales. Urban, rural, and other landscapes, like (often larger) regions, are complex systems: different processes and systems overlap, influence each other, and have a different dynamic of change. These living systems develop over the long term (*longue durée*) and change constantly. Landscapes retain the result of extensive trial-and-error experiments and operations of refinement and improvement over time. In this work, we build upon several durable landscape forms that have developed in the past and continue to recur up to the present day, from so-called "primate" urban centers (Berry, 1961; Crumley, 1976) where an urban form dominates its region, to landscapes with settlements that serve urban purposes but have more distributed forms.

1.3 – **Recognizing Durability: An Archaeological View**

In the next four chapters we provide four case studies from the archaeological record, each of a long-term (centuries to millennia) urban expression. As noted above we find intrinsic value in urban forms that have developed and lasted over the long-term in contrast to those formed by more recent industrialization. Learning from the contrasting *longue durée* offers value to designers, planners, and policymakers.

The selection of the case studies upon which we draw is based on the several sets of conditions and attributes that we believe capture much of the variability found globally and through time. We were looking for examples which might characterize aspects of an urban system that identify both distributed, low-density definitions of a city within a regional context, as well as those regions associated with nucleated, high density urban spaces. To this end, we identified any number of semiarid settings where "classic" urban nodes developed by way of early nucleated populations such as Shang-period China, Indus Valley cities, Highland Mexico, Peruvian urbanism, or even the densely occupied Pharaonic towns along the Nile. Because of its longstanding and rich regional data sets through time, we focused our efforts on the robust southern Mesopotamian example and its countryside. For the same set of reasons, we agreed that the ancient Maya case study would reflect significant aspects of the low-density agrarian urban setting in a tropical environment, because of its well-reported archaeological remains over an extended period of research and study. Although recent work at Angkor and the greater Khmer landscape as well as that of present-day Sri Lanka, West Africa, and possibly even Amazonia provide illuminating examples of the diversity of semitropical urban developments, we feel the ancient Maya provide a Western Hemisphere model which emphasized the limitations of available technologies and the elevated role of resource conservation.

The inclusion of northeast sub-Saharan Africa and northwest Atlantic Europe is an attempt to stress the exceedingly variable engineered landscapes that are now known to have cultivated and harbored highly complex social orders in urban systems with and without sizable monumentality. Sacred spaces are a hallmark of regional integration and durable social institutions, and we have chosen two examples that allow an introduction into the myriad of underreported patterns in which humanity has excelled in its political, economic, and ideological practices and belief systems in producing measurable levels of wellbeing and social complexity. The historical and archaeological record of northwestern Europe does not necessarily emphasize concentrated population nodes or towering temples and palaces, but the region allowed for early notions of shared governance and equity of representation. Like this characterization of urbanscape, the northeastern portion of sub-Saharan Africa includes a wide range of rural settlement adaptations, but the sizable center of Aksum does permit a different view of a city identifiable by its singularity; it is a condition that we do see elsewhere in the ancient world, perhaps most apparent at Teotihuacan in Highland Mexico. Our interest in this latter set of case studies is to challenge the role of urban spaces by lessening the overemphasis on urban nodes.

Our focus is on purely archaeological examples—places where cities once were but are no more. However, we would be foolish to ignore cities that are still occupied today, especially cities that have endured for long periods. These are, after all, success stories: cities that are not only durable, but are still in the process of enduring. Moreover, an active city can in many ways provide greater insight into its operations than an archaeological one. Consequently, we follow our presentation of these four archaeological examples with a chapter in which we examine some extant cities that exhibit the principles of durability. However, we do not abandon our interest in archaeology entirely: even if a city is thriving today, archaeology can be an important component in understanding its developmental history and the way it functions today beneath the surface—literally and figuratively.

It is important to acknowledge that other early urban regions were considered and could have been incorporated, but our interests were to reflect aspects of their variability and dissimilarities, as well as those interpretative assessments that might be similar and shared. Future examinations by our groups, as well as those from other initiatives, are sure to reveal the plentiful and robust precedent for human adaptation and practice for best addressing our futures.

We present our case studies in an order that allows us to move from shorter time scales to longer ones, from smaller areas to larger ones, and from more straightforward cases to more complex ones. This allows us to introduce our themes in a developmental scheme that, we hope, clarifies and better supports our argument.

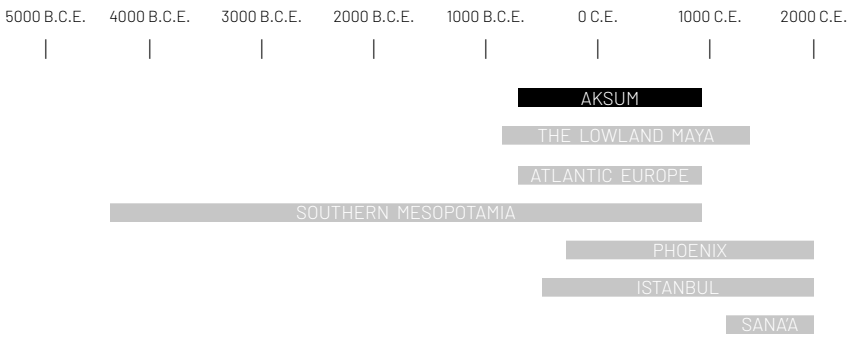
We begin with the Aksumite Kingdom, a case study that demonstrates two important facets of our argument: first, that a durable urban form can be different from contemporary, dense urbanism; second, that a durable urban strategy is one that exploits in a harmonious way its local environmental conditions. In the Aksum case, an extensive political superstructure was supported by a low-density urban form in which agriculture and water management were conducted in a way that befit the climatological and biological affordances in that area. We also can illuminate from the Aksum case that these strategies and structures were durable even as the political and economic trappings of the kingdom fell away.

In the subsequent cases we add more elements to this picture. The Maya case covers a longer time period and wider geographic scope. The geographic scope allows us to examine several different kinds of adaptations, exemplified through case studies of a few different Maya cities, that reflect variations on a theme: similar in some ways, but customized to local conditions (e.g., topography) in others. The expansion of the temporal scope allows us to examine durability in the face of increasingly severe challenges. These are often in the form of environmental changes, and resulting, in the Maya case, in phenomena loosely called "collapse" and/or transformations. This allows us to see a fuller picture of what durability means over the *longue durée*, and how multiple experimental variations in our laboratory of the past play out over time.

In our third case we explore an even wider area and a longer time scale: we examine North Atlantic Europe from the Bronze Age to the Late Medieval period (with an eye to structures still enduring today). Here our focus is on the range of urban forms that divide multiple urban functions in space and time; match an agricultural strategy to the local environmental conditions; adjust to changes in climate and social challenges (e.g., the rise and fall of Rome); and do so within a set of political and economic structures that reflect a more equitable and egalitarian society than that which we see in our two previous examples, and which we might see as an admirable or even enviable model for today.

Our final example, Mesopotamia, is the longest in time, with an archaeological record of nearly five millennia. Here the archaeological record is richly evocative, and the cities, palaces, and art of Mesopotamia have become the stuff of legend in our modern minds. This image seems so larger-than-life that it is hard to consider it small; however, when compared to the immense scale in time and space, the record is in fact very spotty. A record like that of Aksum—one city for a thousand years—becomes just one patch in much a larger quilt, and much of this quilt is still unseen. We can offer some examples from this region that show our principles of durability at work, but we close our archaeological discussion by noting how much more lies in the ground, waiting to teach us more.

2 – Highland Ethiopia



Beginning in the early first millennium BCE the highlands of northern Ethiopia and Eritrea saw a long trajectory of mixed farming, sedentism, and increasing socio-political complexity (Fattovich, 2010; Phillipson, 1997; Schmidt et al., 2008). The first urban settlements emerged with the Pre-Aksumite polity (ca. 800–400 BCE), supported by mixed farming and characterized by the stone architecture of elite residential and ritual complexes. By the late first millennium BCE, Aksum arose as the dominant power, the Aksumite Kingdom (ca. 150 BCE–CE 850), which stretched from the northern highlands to the coastal plains of Eritrea. The Aksumite culture was deeply rooted in earlier developments furthering a monumental architecture of power and growing to a large-scale urban society with multi-script languages and early Christian faith—aspects that remain distinctive of this region to this day. This long sequence of human experimentation in urban growth is of special interest because of its reliance on plough-farming and diverse agro-ecological practices for urban food security in an extensive agro-urban landscape. The kingdom persisted for nearly a thousand years, but it was built on resource management strategies, land tenure systems, and agricultural practices that endured beyond the kingdom that they originally supported. This distinctive way of life has persisted to nearly the present day (at least up to recent conflicts) in the countryside of Aksum and most of northern Ethiopia and central Eritrea, with remarkable continuity in technology, such as the ard-plough; practices, such as rainfall farming; and products, including teff, wheat, and beans.

2.1 – **The Environmental Setting**

Complex societies emerged in this region in the optimal topography between 2000–2400 m above sea level: above the belt of tsetse fly infestation and below the cool, almost temperate climate of the highland peaks. This altitudinal belt with its heterogeneous volcanic geology (granite, basalt, and sandstone) afforded nutrient-rich soils, low-energy hydrological catchments, and productive aquifers, as well as resources for building, craft-making, and trade. Despite these advantages, productive farming in this region had to negotiate a number of constraints: rainfall variability (in timing, quantity, and type); availability of cattle for the plough; the need to store seeds (and protect these from insects) for the next planting season; the shrinking and swelling of clay soils; nutrient depletion; landscape erosion; and the unpredictable threat of locust invasions (McCann, 1995). Yet the early Pre-Aksumite communities were already practicing rainfed farming of cereals and pulses, and limited animal husbandry to support their towns; a tradition that would grow with the rise of the Aksumite Kingdom. The Aksum urban form was highly dependent on the maintenance of steady food production and distribution in the face of these challenges.

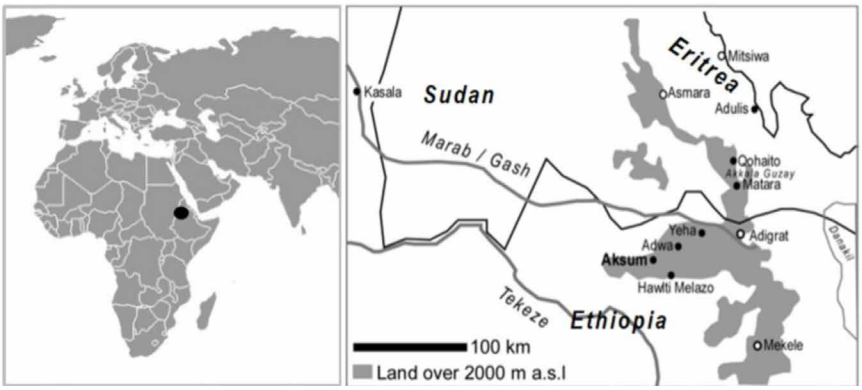


FIG. 2.1 Maps showing the location of the Aksumite Kingdom (see Anfray, 1990; Fattovich, 2010; Phillipson, 2014; Sernicola, 2017). Images courtesy of F. Sulas.

2.2 – **Archaeological Evidence: How Do We Know What We Know?**

The majestic ruins of ancient Aksum have long captured the interests of travelers, explorers, antiquarians, and archaeologists. Aksum was the focus of early descriptions by Jesuit missionaries, the first recordings in the early nineteenth century (Bent, 1896; de Villard, 1938), and large-scale archaeological investigations at the beginning of the twentieth century (de Villard, 1938; Littmann et al., 1912; Phillipson, 1997). These produced a detailed map of Aksumite buildings, giving contours to the monumentality and functional diversity of the ancient city, its seats of power, belief systems, and religions. They provided the foundation for substantial stratigraphic excavations and extensive surveys in the second half of the twentieth century, which began to reveal the spatio-temporal extent and diversity of Aksumite urbanism. Later studies shifted from a focus on the origin and nature of power at

Aksum to sequences of other urban settlements across the wider region: from the Pre-Aksumite towns of Yeha, Matara, and Seglamen, within few miles from Aksum, to Aksumite urban landscapes linking the capital Aksum to the coast such as Qohaito and the port of Adulis (Fig. 2.1). These settlements differed in size and longevity, but their shared subsistence systems and internal and external economies underpinned Aksum's urban growth and expansion into a kingdom (Sulas & Pikirayi, 2020). As studies of material culture, plant, and animal remains from archaeological contexts were illuminating Aksumite lifeways, analysis of landscape sequences and environmental records began to shed light on resource management strategies and their impact on the environment, and responses to climatic and socio-political shifts. Aksum's richly diverse archaeological record is augmented by a long tradition of local and external writings, from inscriptions and ancient Ethiopic manuscript texts—the earliest preserved manuscript dates to the sixth century CE—to the detailed accounts of missionaries, explorers, and travelers who had ventured into the highlands of Ethiopia since the early second millennium CE.

2.3 – **Overview: The Region through Time**

In the late first millennium BCE the Aksumite Kingdom emerged with the development of social complexity and settlement that had begun in the late second millennium BCE. Urbanism first emerged in the center of the Pre-Aksumite polity (ca. 800–400 BCE) at Yeha, a few miles east of Aksum. From its base in the highlands, the polity had important links to the Sudanese lowlands, the Eritrean coastal plains and, across the Red Sea, southwestern Arabia. While political and religious power were centered on the capital at Yeha, there were other Pre-Aksumite urban settlements (e.g., Seglamen and Matara; Fig. 2.1). Toward the fourth century BCE, a new polity emerged on the hilltop of Beta Giyorgis at Aksum, embedding new elements in Pre-Aksumite culture. This hilltop settlement began to give way to new monumental residential and funerary complexes along the southern pediment: less than 300 m below, the new Aksumite capital sprang up at the mouth of a vast alluvial plain.

For about 600 years Aksum occupied a position within an extensive trading system, linking local resource production with networks across the Sudanese lowlands and along the Red Sea coast (Fattovich, 2019). Control over the latter enabled Aksum to operate at the intercontinental scale, reaching the Mediterranean regions and the Indian Ocean network. This prominence would persist for a thousand years, declining only around the ninth century CE, coincident with geopolitical transformations and changing trade networks as well as periods of excessive rainfall and dry spells (Fattovich, 2019) that fluctuated at regional and continental scales.

2.4 – **The Urban Form**

The stone monuments of Aksum (see Box "Aksum") are impressive reminders of the power and glory of the old kingdom (Figs 2.2 and 2.3), but more enduring and impressive are the remains of the extensive agro-urban activities that originally surrounded and supported the city and were in turned shaped by it.

The landscape around the city was transformed. The apparent constraints of a bi-modal climate, diverse geography, and topography were turned into opportunities in a number of ways. Ploughing along the edge of topographic breaks, the building of low ridges, and management of tree patches helped to control soil erosion. Localized soil erosion would bring nutrient-rich fine alluvium for replenishing farm soils downslope. Additional nutrient input would come from cattle grazing over the plot after harvesting (dung), domestic waste (ash, organics, etc.), and an agile farming cycle. Sowing of drought-resistant crops just before the major rainy season would not only time seed germination so that sprouts would be watered at a critical growing point, but in turn these would provide a protective cover at the time of greatest rainfall erosivity. As teff, wheat, millet, and other grains were reaching maturity, the sowing of pulses such as lentils and beans would contribute to soil health—binding nitrogen, for example—and providing a diet rich in vitamins and nutrients. In addition to aligning the farming cycle to annual weather conditions, multi-year crop rotation by alternating grains, pulses, and fallow over the same field was key to maintain soil health. Farmers used these techniques to support a highly productive rainfed farming of cereals and pulses (Boardman, 1999; D'Andrea, 2008).

The farming practices that supported the kingdom outlived it; indeed, several of the crops attested from the late first millennium BCE are still grown today. Parts of the infrastructure survive intact: the ancient Aksumite reservoirs continue to provide the most reliable water supply for local communities (Sulas, 2018). This durability was not solely material. The social customs and practices that supported the creation and maintenance of these structures were key. We can see this in the management of primary resources: water, land, and oxen (Fig. 2.4).

Water reservoirs were constructed and maintained through collaboration within the farming community. There is no evidence of private property in the Aksumite period, but later medieval sources detail a land tenure system with deep historical roots (Crummey, 2000). Although in theory rights to land derived from the king, land and water resources were managed almost independently by the farmers. Farmers could inherit use rights and bequeath them to their children so long as taxes (or tributes) were paid. A similar system was in place for collective village ownership of land. Landlords holding fundamental rights in land could give farmers access to land under terms of tenancy. No particular institution was associated with the use and management of water. Traditionally, rivers, springs, and any other form of water source were used collectively by the village community, though small ponds and shallow wells would be owned by households. Communal ownership and maintenance applied to deep wells, river diversion, and small dams. In historical records, for example, there is mention of farmers clearing canals that irrigated plants of the church (Sulas, 2018).

AKSUM

Today a UNESCO World Heritage Site, Aksum is known for its exquisitely carved monolithic stelae (the tallest still standing is over 23 m tall; Figs 2.2 and 2.3); it is littered with the ruins of monumental residential, ceremonial, and funerary complexes built in local hard rock (trachyte) affording angular plans, recessed walls, and multiple stories where brick and timber were also employed (Phillipson, 1997, 2014).

Most of these are found alongside the southern foothill of Beta Giyorgis, overlooking gently sloping land into a wide alluvial plain. The remains of stone-walled large water reservoirs next to monumental complexes attest to urban services for subsistence, sanitation, and ritual needs. (Finneran, 2014; Sulas, 2014) Around the monumental core, lower elite residences and small farmsteads dotted a dispersed and loosely spaced fabric of arable fields and pastureland where surplus food production could be protected and easily moved across the agro-urban landscape. Smaller, domestic residential units also were built in stone with undressed and mortared walls, shaping rectilinear plans and narrow alleys. Whether or not these structures hosted the vast majority of Aksumites remains open to debate since architecture built in perishable materials has not yet been recorded. Indeed, the traditional basic dwelling for the highland communities is the hidmo (or tukul), a circular structure made of straw, dung, and mud walls supported by a timber frame (Bekele Jetie, 2019; Lyons, 2007).

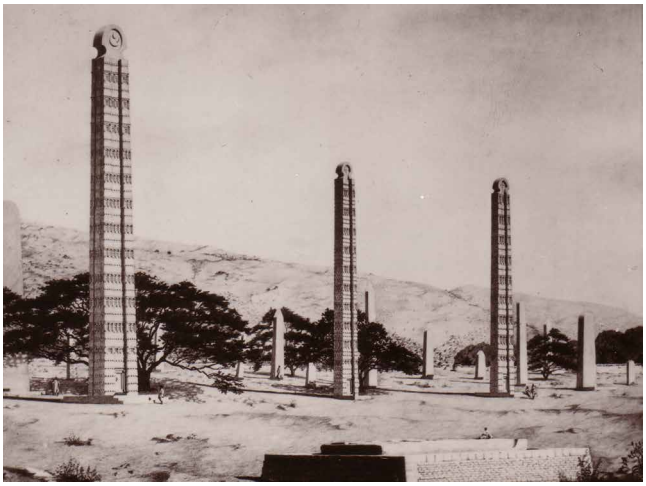


FIG. 2.2 The Stelae Park at Aksum in 1906. Drawing produced by the Deutsche Aksum-Expedition (Littmann et al., 1912). Reproduced with permission from digital copy of the original held in the Aksum Archive at the British Institute in Eastern Africa, Nairobi (photograph reference number: Nachl. 245 K. 43, Seq. 43.8). Image used with kind permission of the BIEA's director Dr Jane Humphris and country director Dr Freda M. Nkirote.

FIG. 2.3 The stela field in 2006. Image courtesy of F. Sulas.

FIG. 2.4 View from Aksum countryside, November 2007: farmer using the traditional Ethiopian ard-plough to prepare the land for sowing. In the background, low earthen ridges and patch of Eucalyptus trees purposely maintained in between fields. Eucalyptus trees were introduced to the country in the late nineteenth century CE. Image courtesy of F. Sulas.

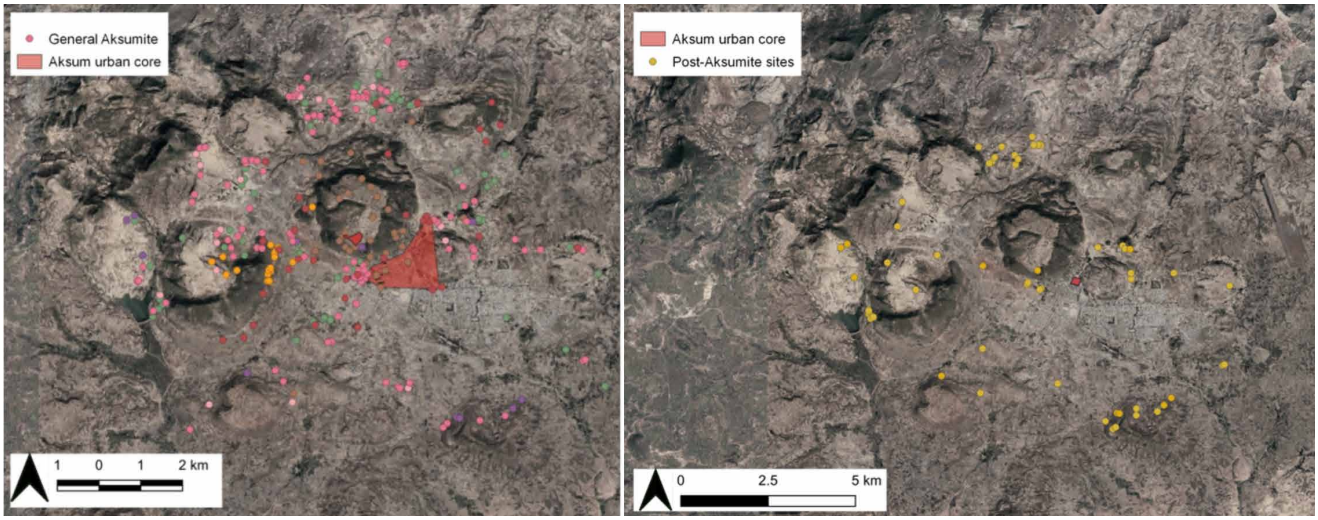


FIG. 2.5 The distribution of major Pre-Aksumite and Aksumite settlements (left) and of Post-Aksumite sites surrounding the ancient urban core (right; see Anfray, 1990; Fattovich, 2010; Sernicola, 2017). Images courtesy of F. Sulas.

Archaeological records attest the presence of oxen, the other resource essential to Aksumite farming. Historical sources and traditional practices show that wealthy farmers would share their oxen with those who needed them for ploughing.

The maintenance of these key resources—water and healthy soils—depended on individual actions informed by collective needs. Shared responsibility also means that adaptive strategies and responses to changes rely on collective ecological knowledge (see also Isendahl, 2002).

The demise of urban elites generated a reorganization of the agro-urban landscape, but one that maintained local food production; even as the capital's urban core contracted, farmsteads gradually increased (Sernicola, 2017) and persisted for the next thousand years (Fig. 2.5). Post-urban Aksumite farming settlement, agro-ecological practices, and structures persisted in spite of the droughts and political and economic turmoil that punctuated the following centuries (Marcus, 2002; Selassie, 1972; Taddesse Tamrat, 2009; Zewde, 2001).

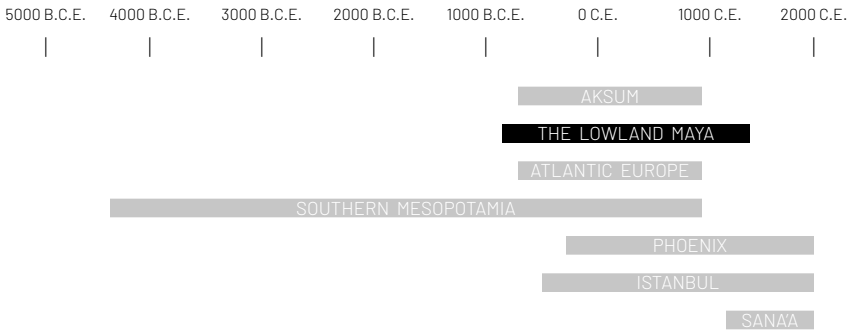
Over time, diversification in the management of key resources (water, soil, crops, vegetation cover, domesticates, and game) and socio-ecological know-how produced a distinctive biocultural heritage (Ekblom et al., 2019). Three millennia of development and diversification enabled the production of surpluses to support urban growth in this agro-urban landscape (sensu Isendahl, 2012). A collective action predicated upon individual understandings and needs made the basic building block of the Aksumite urban landscape—the farmsteads—durable. The Aksumite Kingdom experienced collapse and the disappearance of Aksum as a capital, but this did not translate into a complete breakdown of the agro-urban fabric. In fact, as the core monumental urban space contracted and was eventually abandoned, the farming units not only persisted but actually increased in number in and around Aksum.

The growth, longevity, and durability of the Aksumite agro-urban landscape was based on deep place-based, socio-ecological know-how for the prediction of rainfall (time, amount, type) and management of soil moisture, water excess and shortages, and soil erosion. Understanding environmental conditions was also both a driver and an outcome of a dynamic, permeable, and responsive learning that local communities nurtured over generations.

2.5 – **Highland Ethiopia as an Ancient Urban Laboratory**

We see in this example how the accumulation of local knowledge, the elaboration of local practices, the establishment of appropriate norms and institutions, and the accompanying transformation of the local landscape can become a durable strategy, one that outlasts the political structure that originally gave rise to it. We will see these same dynamics in our subsequent examples, where we will also see how such systems can respond to more dramatic challenges over greater spatial and temporal scales.

3 – The Maya Lowlands



The ancient Maya lived in what is today Guatemala, Belize, Honduras, and southern Mexico (Fig. 3.1). Farming became a way of life about 4000 years ago, initiating millennia of adaptive experimentation and creativity. From the early first millennium BCE the Maya developed alternative urban forms that have been characterized as "low-density cities" and "agro-urban landscapes", describing forms of urban settlements in which residential buildings are relatively dispersed in the landscape and integrate with diverse agricultural and water infrastructure (Isendahl, 2012; Lucero et al., 2015). This allowed for significant agricultural production in the city fabric. Production was highly diverse: the Maya produced food from an array of plants (Fedick, 2020) in very different environments and in demographic, socio-economic, and political settings that varied over space and changed over time. Over a period of about 2,500 years, pre-Columbian Maya urban history unfolded not linearly, but as a complex series of growth, decline, and reorganization trajectories, including the famous (but disputed) "Maya collapse" around 800–900 CE. As these trajectories progressed, the hub of Maya culture shifted northward into the northern lowlands and underwent corrective adaptations of these socio-ecological systems, but the general low-density pattern of cities largely persisted.

3.1 – **The Environmental Setting**

The environments of the Maya lowlands, encompassing the southern lowlands of Guatemala, Belize, and regions to the south, and the northern lowlands in what is today the Yucatan Peninsula, are and were highly variable in terms of precipitation, hydrology, topography, soil cover, and vegetation. This wide variation presented different combinations of opportunities and challenges for the pre-Columbian cities and urban systems.

Too often the northern and southern regions of the Maya lowlands are conflated, but they have different histories and present different environmental challenges and opportunities for the emergence and development of cities (Fig. 3.1). The southern lowlands were the heartland of early Maya urbanism. While today the areas that the Maya occupied are rich, lush, tropical forests, this was not the way the landscape looked during all the periods through which the Maya lived in these regions. The southern lowlands are rich in plant species, but the fertile tropical soils—some of the most fertile soils in the world—are dispersed in variously sized pockets that rest on a porous limestone through which much of rainfall percolates (Lucero et al., 2014). About half the year sees consistent and sometimes intense rainfall, while the other half is extremely dry. Because the limestone drains water quickly, the same area that sees flooding during the rainy season risks water shortages during the rest of the year. About 40% of the landscape is seasonal swamp, though the rich diversity of plant and animal species are highly dispersed across the region. The climate of the Maya lowlands is susceptible to a series of anomalies, including hurricanes and tropical storms as well as droughts, and climatic reconstructions of past precipitation suggest that a series of prolonged droughts struck between ca. 800 and 930 CE (Medina-Elizalde et al., 2010).

The northern lowlands that make up most of the Yucatán Peninsula have lower elevations and thinner soils than the southern lowlands. In contrast to the southern lowlands, some parts of the northern lowlands, such as the northern coastal plain, have a higher and much more accessible water table. The region also contains nearly 7000 *cenotes*, natural steep-sided sinkholes fed by groundwater (Schmitter-Soto et al., 2002). The southern lowlands have higher elevations, and thus a lower water table and many fewer *cenotes*.

FIG. 3.1 The Maya world with a few of the most well-studied urban settlements indicated (plotted by L.J. Lucero on a modified map from NASA, https://www2.jpl.nasa.gov/srtm/central_america.html; accessed November 22, 2011).

3.2 – **Archaeological Evidence: How Do We Know What We Know?**

Our knowledge of the Maya comes from a variety of sources. Some of what we know we have learned from the Maya themselves, who are still living in the region today; likewise, the accounts of the Spanish colonizers provide some insights (though this knowledge is heavily outweighed by the extent to which they destroyed Maya cultural heritage; see Box "A Cosmological Worldview"). Our most revealing awareness of deeper time in the Maya world is generated from archaeological research. North American and European explorers in the nineteenth century reported "lost cities" defined by elaborate buildings and sculpture; archaeological excavations began early in the twentieth century and expanded over time into the scientific enterprise of today. Over the last half century, archaeological research in the Maya lowlands has intensified precipitously. Archaeologists are working together with scholars of cognate sciences (for instance, architects, soil scientists, and botanists) to examine a host of different aspects of Maya cities from a multitude of perspectives by employing different approaches, including large-scale multi-year projects focusing on detailed multi-disciplinary investigations at large urban sites, allowing the establishment of chronologies of the emergence and spatial patterning of lowland Maya urban forms. Many archaeologically recovered monuments incorporate hieroglyphics. Initially unreadable, perhaps 80% have now been deciphered; they are elaborate urban histories of the rituals, wars, and alliances forged among competing city-states (Martin, 2020), told from the perspective of city-state royal elites. Large-scale survey, usually difficult in the tropical vegetation of the lowlands, reveals that the monumental civic-ceremonial precincts of the urban elite formed city centers and were only a small portion of an extensive and dispersed agro-urban Maya landscape settlement pattern (Fig. 3.2). More recently, LiDAR, a remote sensing technology that allows researchers to "see" the ground surface by using laser scanning and computers to mathematically strip away the thick vegetation over large areas, has sped the pace of discovery and revealed more about the way the Maya transformed their landscape (Chase et al., 2011). Together these approaches have provided a rich data source for understanding the Maya and their world.

FIG. 3.2 Archaeologist Pat Culbert (right) and a tourist look out from one of the many monumental structures in the urban core of the Maya city at Tikal. Image courtesy of J.T. Murphy.

A COSMOLOGICAL WORLDVIEW

The Maya provide an extraordinary example of how the physical infrastructure of the city was indivisibly linked with an ideological framework, a larger worldview that contributed to the durability of the urban form and of the society it supported.

Much of what we could know about Maya cosmology was stolen from posterity by European colonizers. The Maya produced elaborate and beautiful documents that contained Maya mythology, religion, history, and astronomy. European conquerors, committed to converting the Maya to Christianity, destroyed these systematically, deliberately, and sometimes en masse, with public bonfires consuming in a few minutes millennia of Maya history, knowledge, and beliefs, consigning them to smoke and ash. Only four examples of these codices survive (Fig. 3.3).

Many Maya records, however, were more durable. The Maya wrote on stone in murals that have, miraculously, survived the forest's damp pressure, and they made elaborate stone carvings and paintings (Fig. 3.4) on and inside buildings and on monuments that lined the streets and plazas of their cities. Many Maya ceramics and terra cotta vessels, censers, and figurines exist, decorated with writing and pictures that escaped the Europeans' zeal. Maya writing was rich and complex, a mixture of word-pictures and syllabic signs; about 80% of the known examples have been deciphered.

The story that we glean from these records suggests a cosmocentric worldview (Lucero, 2018), a way of seeing the world in which people were not the center. Instead, just as there was no hard boundary between forest and city, people were part of their world, and existed alongside the plants, animals, and natural forces of the Maya universe. This worldview differs from an anthropocentric one in that it positions humans, things, animals, land, and water on the same plane; each plays a role in maintaining themselves and the world. This merged world is reflected in Mayan languages of today, which have no terms for "religion" or "nature" (Pharo, 2007) because their daily existence encompasses a merged world with which they engaged via ceremony and ritual in the home, garden, field, and city, as well as pilgrimages throughout the landscape (Bassie-Sweet, 1996).

We speak today of Maya urban forms in terms of water management and of integrating urban and green space into the urban environment; these concepts might not have fit within the Maya mindset. The engineering feat of a Maya city was spectacular, but our vocabulary of controlling nature to carve out a separate space for people (and then, perhaps, inserting "green space" into that non-natural space) might have been very foreign to the Maya. Their cities were less built "out of" the landscape, and more "built from" the landscape. That the Maya transformed the landscape is without doubt; but the Maya would have seen this as an organic process, and one that placed human beings in a larger system, alongside—rather than in place of—the natural world.

The durable cities that we envision for our own future need not have the same worldview as the Maya; we would not expect our view of humans' place in the cosmos to change quickly, nor, of course, to match the view of the Maya at any specific level of detail. But portions of their outlook are appealing, and would help to frame the way that we envision how cities and urban regions function, to guide the design of new solutions, and to select from among competing possibilities (Lucero & Gonzalez Cruz, 2020). Moreover, we propose that an important aspect of durability is to recognize that worldview matters: that the residents and citizens in an urban region have a framework that places them in a durable system. Modern infrastructure too often conceals what should be celebrated; if the denizens of tomorrow's urban areas see the movement of water and energy around them and understand that it is a system of which they are a part, we believe it will help to guide urban decision-making toward both physical and social durability.

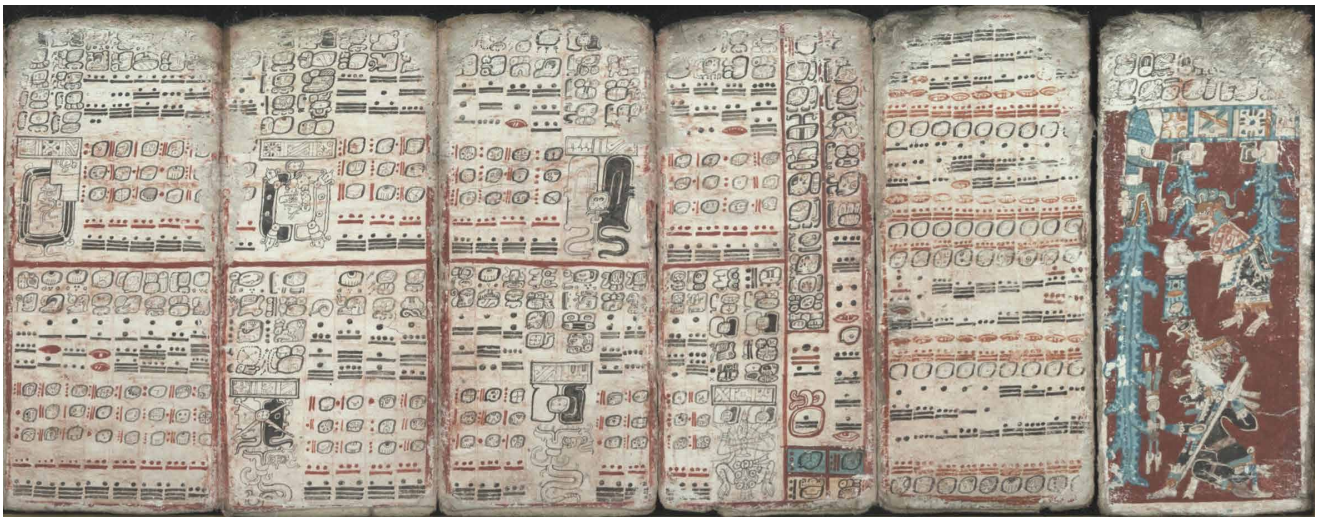


FIG. 3.3 Six sheets of the Dresden Codex. Image in public domain, via Wikimedia Commons.

FIG. 3.4 A Maya mural at Bonampak. Image by Wikipedia User Inakiherrasti, Creative Commons Attribution-Share Alike 3.0 Unported (https://creativecommons.org/licenses/by-sa/3.0/deed.en).

3.3 – **Overview: The Region through Time**

The Maya indigenous urban trajectory includes three main phases: the Preclassic, the Classic, and the Postclassic. Maya cities from all these periods went through phases of growth, florescence, and decline (Fig. 3.5). The Preclassic (ca. 900 BCE – 200 CE) saw the florescence of the first major centers, such as El Mirador and Nakbe, but the Classic (ca. 200–900 CE) saw the rise of the most distinctive and dramatic Maya art and architecture; it is largely from this period that we inherit our image of the "mysterious" Maya. This art reflected the dominance of an elite, royal class, with a shifting constellation of alliances and conflicts among the royal lineages of the prominent Maya centers such as Tikal (see Box "Tikal"), Caracol (see Box "Caracol"), Calakmul, Copán, Palenque, and many others. These economic and political strategies maintained the urban system of the Classic period in the southern lowlands and persisted for 700 years.

The Classic period ended in dramatic changes around 900 CE, when most of the large cities in the southern lowlands declined and were abandoned. The apparent dissolution of elite power was the most pronounced expression of these processes, as the art and architectural program supporting the royal classes ended. This is often described as a "collapse", but most archaeologists today examine these changes as reorganizations of a larger and more enduring system of which cities and kingship were facets. Basically, coercive—at least in part—political institutions collapse, while farmers continue tending their land and crops, albeit in more dispersed communities and smaller towns.

We know how this happened in some detail. When prolonged droughts struck between ca. 800 and 930 CE, water deficits had major repercussions for southern lowland cities (Douglas et al., 2015). Droughts impacted regional agricultural schedules, forest health, and trade networks. Increasing competition among city-state ruling classes for capital accumulation led to overexploitation of resources and labor; most cities did not recover from the cascading effects of conspicuous consumption, asymmetric access to wealth and services, conflict, over-population, soil erosion, deforestation, trade disruptions, and so forth. The processes set in motion by prolonged droughts were met with varied and multi-faceted responses. Economic collapse was precipitated in part by the interdependency and connectivity of Late Classic (ca. 550–850 CE) urban systems. Ultimately, up to ca. 90% (Turner & Sabloff, 2012) of the farmers that made up the bulk of the urban population left the southern lowland interior areas to live near major rivers or large lakes (e.g., Belize River, Lake Petén Itzá) or coastal areas where market towns and trade thrived (Lucero et al., 2015; Sabloff, 2007). Most centers in the southern lowlands were never reoccupied after the tenth century CE, which speaks to the long-term repercussions of a trajectory towards over-exploitation that the multiple droughts merely hastened. This drastic resettlement adaptive strategy worked, as evidenced by the over seven million Maya currently living in Mexico, Central America, and elsewhere (McAnany & Negrón, 2010).

The Postclassic (ca. 900–1450 CE) saw a massive shift away from the Classic period Maya heartland in the southern lowlands as population centers northward on the Yucatan Peninsula, where they lasted almost until the European conquest began in the early sixteenth century. Dramatic and large-scale architecture resumed here, including well-known sites such as Chichén Itzá, Mayapán, and Tulum.

FIG. 3.5 Maya urban centers included dramatic settings, presumably for religious or political ritual. This was true from the Preclassic (e.g., the site of El Mirador (bottom left), which was occupied beginning before the 5th century BCE and includes one of the earliest and largest Maya pyramids) to the "collapse" (e.g., the site of Aguateca (bottom right), which was invaded, burned, and abandoned during the Late Classic, around 800 CE), and through to the reorganization in the northern regions (e.g., the well-known site of Chichen Itza (top), constructed and occupied beginning around 750 CE). Top: Daniel Schwen, Creative Commons Attribution Share-Alike 4.0 International (https://en.wikipedia.org/wiki/File:Chichen_Itza_3.jpg); Bottom left: Dennis Jarvis, Creative Commons Attribution Share-Alike 3.0 Unported (https://commons.wikimedia.org/wiki/File:Flickr_-_archer10_(Dennis)_-_Guatemala_1828_-_La_Danta_at_the_Mayan_site_of_El_Mirador.jpg); Bottom right: Sébastian Homberger, Creative Commons Attribution Share-Alike 3.0 Unported (https://commons.wikimedia.org/wiki/File:Aguateca-plaza.jpg).

TIKAL

FIG. 3.6 The Central Plaza at Tikal. Image by by Bjørn Christian Tørrissen, CC BY-SA 3.0, https://creativecommons.org/licenses/by-sa/3.0, via Wikimedia Commons.

One of the pre-eminent Classic Maya city centers is that at Tikal (Fig. 3.6). Tikal is instantly recognizable for its monumental architecture. The North Acropolis, flanked by two monumental temples, with a ballcourt (one of five in the central precinct) and rows of inscribed and decorated stelae, belies its complexity: it served for 1300 years not as a city for the living, but as a royal mausoleum (Coe, 1990). Nearby Temple IV towered over Tikal's population; at ca. 70m it is the tallest pre-Columbian structure in the Americas. Causeways connected temple complexes and palaces and served as walkways for processions. It was a city of ritual splendor, and at its height it was home to about 80,000 people (Lentz et al., 2015).

Tikal was supported by a generous resource base: the city was perched on hilly terrain surrounded by large pockets of rich agricultural soils. The central challenge was not soil, but water. Tikal had a highly interconnected reservoir system that controlled water from the top down (Fig. 3.7). During the wet season the largest tanks within the summit topography would fill with runoff from the many well-designed paved surfaces, including the grand pyramids (Fig. 3.8). This acted to provide water for dry season gravity flow release to the more densely occupied residential slopes of the city. Causeways also served as reservoir dams. The waters were actively managed with sand filters at the ingress to the large reservoirs, likely driven by the need for potability and the fact that the catchment surfaces from which water was directed were the same as those used for markets and quotidian-related activities. The system provided drinkable water before it was fouled by use and recaptured as grey water at the foot of the hillock on which the uptown city was positioned. At the bottom of the system, a series of swamp-margin reservoirs were used to contain this cascading flow for later release to low-lying fields moistened at the height of the dry season, perhaps allowing for a third cropping event.

At Tikal, population growth resulted in a greater reliance on increasingly larger and more sophisticated reservoirs (e.g., sluices, dams, channels, filtration, etc.), a trend that continued through the Late Classic (Scarborough, 2003, 2007). Over time, urban planning and layout became inextricably linked with reservoir systems (Scarborough, 1998; Scarborough et al., 2012). Furthermore, maintaining water quality would have been crucial to curtail the presence of water-borne parasites and diseases and the build-up of noxious elements (Lucero et al., 2011).

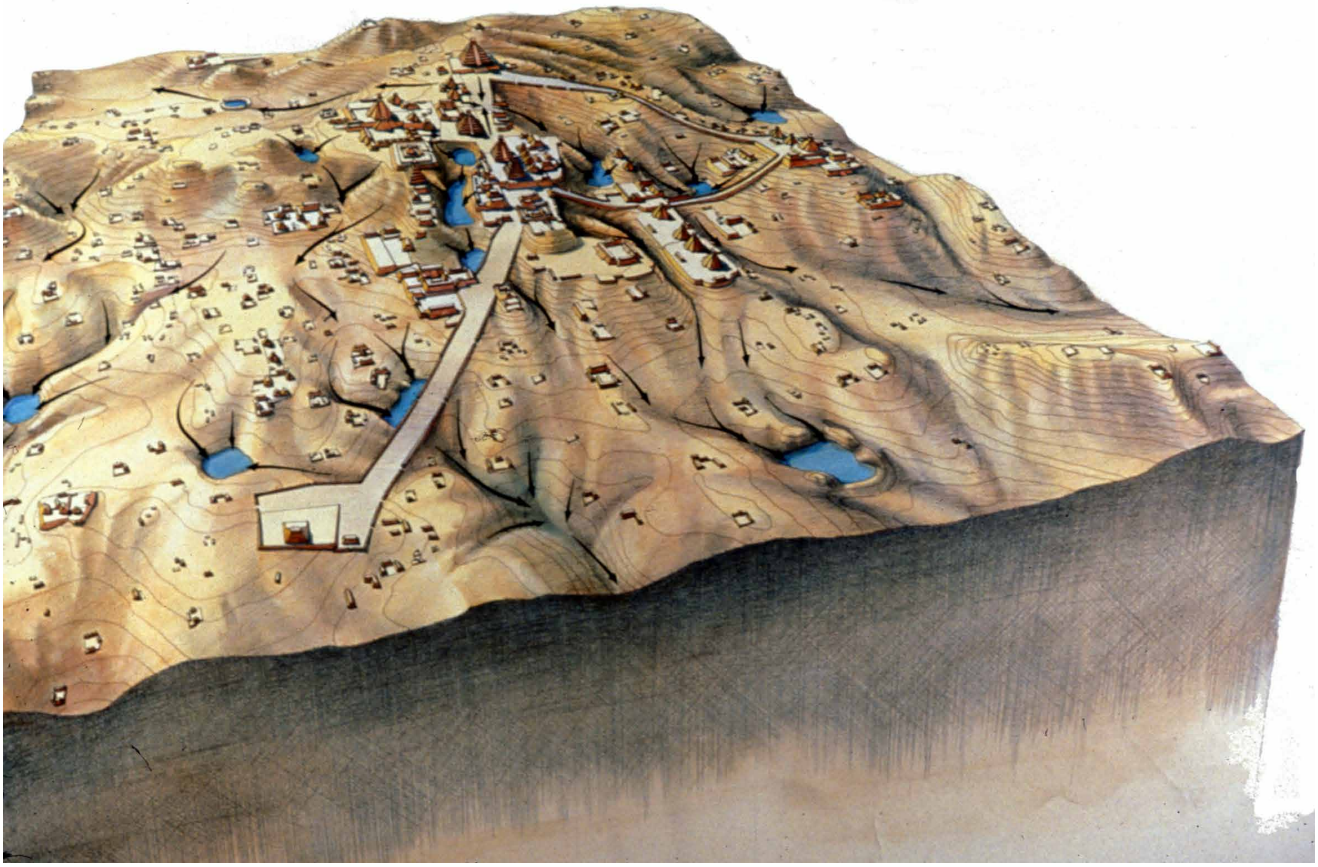


FIG. 3.7 Plan of Tikal showing topography and water management features. Image courtesy of V.L. Scarborough.

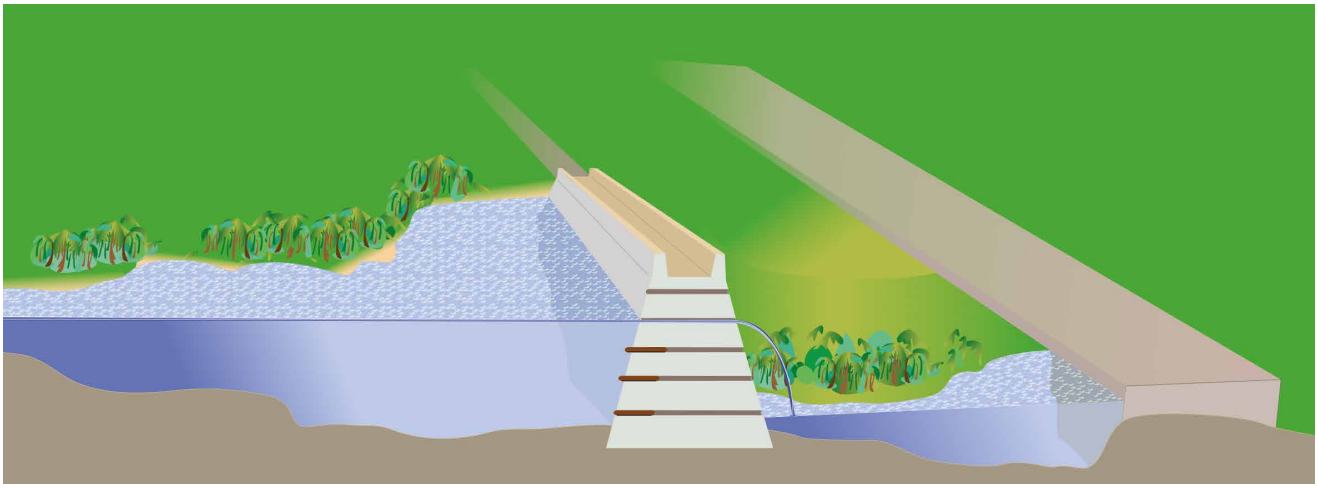


FIG. 3.8 The Palace Reservoir Dam at Tikal (700–800 CE); 80x60x10 m high gravity dam with cut stone veneer, viscous bajo clays as sealant, and possible earthen revetment and small stacked sluices (30 cm in diameter). Image courtesy of V.L. Scarborough.

CARACOL

A close cousin to Tikal in both size and grandeur, Caracol during the Late Classic was an expansive city: by 700 CE its population was as high as 100,000 people (Chase et al., 2011; D.Z. Chase & A.F. Chase, 2017). It was interconnected by a road system for communication and transport that integrated an exchange system that focused on localized markets. Like Tikal, Caracol integrated water management features into monumental architecture: the main temple and palace complex (43.5 m tall) has three pyramid temples at its summit and sits across a plaza facing a water temple that abuts one of its two major reservoirs (A.F. Chase & D.Z. Chase, 2017).

The terrain was hilly at Caracol, but the soils were fertile. However, the ancient Maya enhanced the landscape through the construction of agricultural terraces spread over 200 km2 by the end of the Classic period (Fig. 3.9; Chase et al., 2011). Thus, foodstuffs did not need to be imported into Caracol, as they were at Tikal (Chase & Cesaretti, 2019).

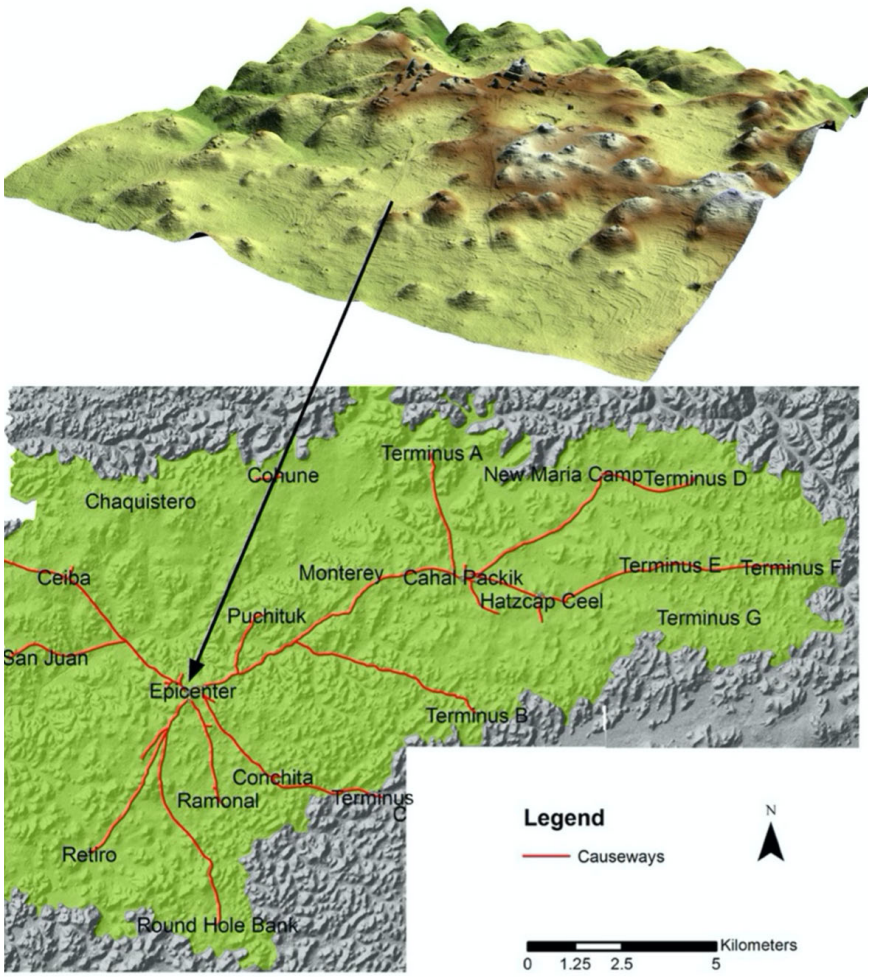


FIG. 3.9 Position of the center of Caracol, its further connections, and a LiDAR-generated topographic view. From Chase et al., 2011, p. 394 (top) and D.Z. Chase & A.F. Chase, 2017, p. 187 (bottom). Used with permission.

3.4 – **The Maya Urban Form**

Cities first emerged in the southern lowlands more than 2500 years ago and expanded in number and size over time in parallel with population growth and an emerging socio-economic system of political control. Urban origins in broader Mesoamerica can be traced back into the second millennium BCE, but the earliest Lowland Maya cities emerged in the southern lowlands during the early first millennium BCE. The Maya adapted to their environment without beasts of burden, the wheel, metal tools, nor likely the sail. In place of these, the Maya relied on physical labor and stone, clay and wood technology to build and expand each city incrementally; the extent of expansion related to the amount of labor early leaders and later kings controlled, as well as local resources and topographic relief.

Recent archaeological evidence indicates that the Maya initially followed orthogonal urban plans (Fig. 3.10). The first towns of consequence are sometimes identifiable by grid-pattern layouts as early as 600 BCE (Pugh & Rice, 2017). An orthogonal plan is an energy-efficient way to organize built space (Fletcher, 2009; van der Leeuw, 2019), and these early Maya cities are akin to many others across the world and through time. But this dense, orthogonal system to organize social space was soon abandoned. It was replaced by a more dispersed and less geometrically consistent settlement pattern that better addressed challenges and opportunities of a local mosaic tropical environment and associated topography. These became the true expression of Maya cities with new urban forms that were expansive upon the landscape (see Boxes "Tikal", "Caracol", and "Saturday Creek"). Maya communities were highly socially distanced: the densities of buildings (including elite and commoner residences as well as public buildings) were lower by an order of magnitude than in the cities of the Near East and other semiarid settings.

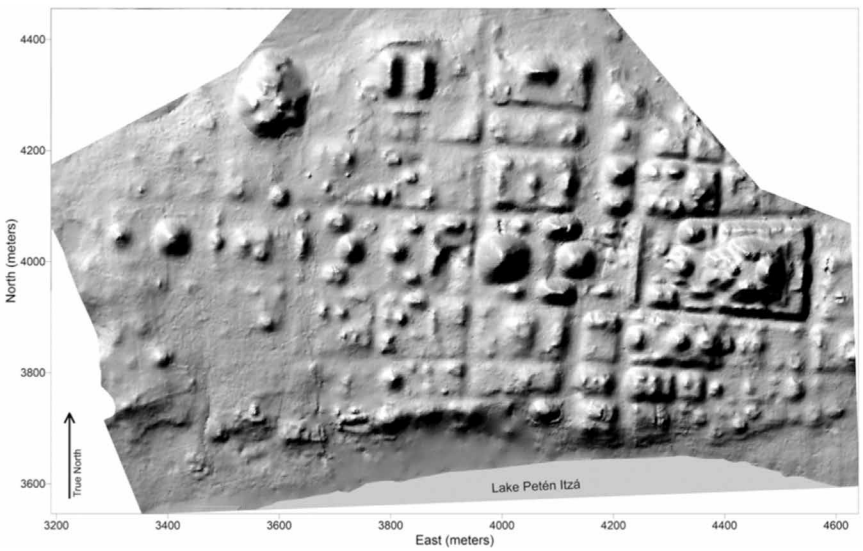


FIG. 3.10 Orthogonal plan of the early center at Nixtun-Ch'ich. From Pugh & Rice, 2017, p. 582. Used with permission.

Several interrelated factors contributed to this mode of Maya urban planning: (1) it followed the tropical ecosystem's tendency towards dispersed resources and species distributions; (2) it was a consequence of integrating farming and gardening in near-residential contexts within the city fabric; and (3) it reflects the tension between centrifugal (population autonomy) and centripetal (elite control and the benefits of proximity to urban services) social, economic, and political forces. In this light, the earlier, orthogonal forms can be seen as failed experiments with an urban model poorly adapted to the ecologies of the humid tropics.

These low-density cities integrated centers with dispersed farmsteads and other concomitant features. City centers contained temples, palaces, plazas, ballcourts, elite and, usually, upper commoner residences, causeways, and open areas. Wealthier Maya lived in houses built with cut limestone walls and thatch or stone roofs (corbel vaulted). Elites and royals lived in larger plastered multi-room buildings, compounds, and palaces. The majority of Maya farmers occupied thatched houses, sometimes with limestone walls, and with plaster floors, quite suitable for the humid tropics. Farming plots were integrated in the Maya city fabric: a variety of food and medicinal plants were grown in near-residential gardens, in orchards, and in larger non-built spaces. Farm plots and fields and orchards of fruit trees (e.g., avocado) probably generated a relatively lush type of city. These agriculturally productive areas would have provided shade and relief from the tropical sun, contrasting to the heat radiating from the plastered causeways, plazas, and building facades in the monumental city centers (though they were sometimes painted in bright colors) (Graham & Isendahl, 2018). Urban and peri-urban agriculture was thus interwoven with other urban functions to form agro-urban landscapes (Isendahl, 2012).

As the majority of city dwellers were farmers on location, we may speculate that the connection between (urban) people and their (urban) land was intimate: the farmers acted as custodians of (urban) soil (Evans et al., 2021). Maya farmers had an intimate knowledge of their environment. Their strategies varied widely by region and at smaller scales, each locale finding practices that fit with local environmental conditions, the nature of the landscape, and available resources. Small-scale extensive and intensive agricultural strategies to manage soil and water (e.g., low terraces, reservoirs, short canals, and raised fields) were employed to grow the staples of indigenous maize, beans, and squash, as well as a host of other crops in house gardens, short-fallow infields, long-fallow outfields, and combinations of these techniques. These strategies balanced topography and water availability along with other constraints. For example, Maya farmers likely cultivated both domesticated and non-domesticated plants in noncontiguous plots, arranged strategically to prevent the spread of pests. These varying strategies also reflected differences in available technologies, socio-political structure, and cultural traditions.

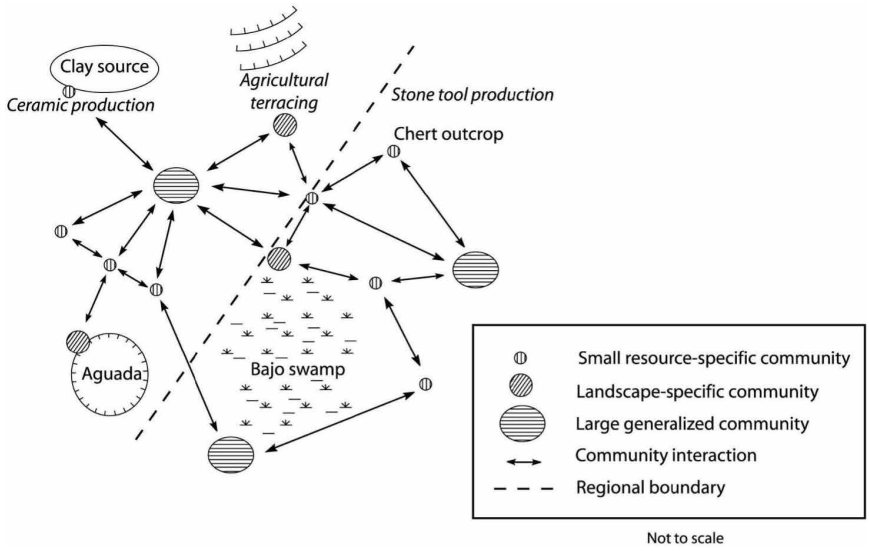


FIG. 3.11 Schematic of local resource specialization and dual economy system. Image courtesy of V.L. Scarborough.

The differences between the sizable urban centers of Caracol and Tikal offer a case in point. At Caracol, the patterning of the agro-urban landscape was determined by the hilly landscape. Exploiting this resource required extensive hillside agricultural terracing, transforming the landscape and forming the backbone of a dual economy (Fig. 3.11). Hilltop summits served as the foundation for household dwellings, elite residences and public and ceremonial spaces, the latter two integrated by an elaborate system of causeways. At Tikal, far less hilly and surrounded by *bajos* (seasonal wetlands), productive dry and wetland farming generated a markedly different, locally adapted form of the integrated agro-urban landscape, in which soil humidity, rather than slope, was managed to generate the local economic basis of the city, which also required trade in foodstuffs to survive (Chase & Cesaretti, 2019).

SATURDAY CREEK

Smaller communities adapted to the diversity of both organic and inorganic resources by cultivating specific assets, refining either their access through conservation or by investing in skills to best enhance or produce a trade goods (Crumley, 2003; Scarborough et al., 2003). These resource-specialized communities established socio-environmental linkages and interdependencies between groups of small communities; they sometimes shared specific social functions, like visiting the neighboring small center with the region's only ballcourt (an important arena for identity-marking politico-religious ceremonies), or drawing from a principal water reservoir excavated by one community, but understood by the greater cooperative of communities as the locus for predictable freshwater. On occasion, many of these community resources converged at a one centralized place resulting in the initiation of urban functions clustering in a "city". The economy, then, was a dual one (Fig. 3.11): the very dispersed resource-specialized communities maintained their agricultural functionality but operated within the orbit and centrality of truly urban developments (Scarborough & Valdez, 2014).

Saturday Creek, Belize is a smaller, minor center with an extremely long occupation history (Fig. 3.12). Occupied continuously for over 2,400 years (ca. 900 BCE – 1500 CE; Lucero, 2006, pp. 67–113), the town sat on a floodplain along the Belize River. It did not have a reservoir system, king, or hieroglyphic record, but rather persisted in an area with high rural density. In addition to the fertile alluvium and plentiful resources and freshwater access, local residents took advantage of what the Belize River offered or attracted—fish, fowl, water, reeds, game, snails, etc. Farmers were still rainfall-dependent, since the entrenched riverbed did not permit irrigation. Socio-economic stratification was apparent in the differential residential sizes and distribution of exotic goods (e.g., obsidian, jade, polychrome vessels, etc.). Due in part to its plentiful resources and its location along a major trade route, this stratification did not grow to include true kings; instead, Saturday Creek probably remained in the orbit of more powerful city-states, like Tikal, in the Classic period. Management strategies were community based; elite families likely organized labor parties to expand in increments by way of small temples (the tallest being 5.4 m tall with a 2100-year use-history) and a ballcourt. Saturday Creek's durability was likely due to its flexibility and resilience, since it had not locked itself onto a costly high-investment and maintenance-dependent set of solutions for long-term durability. The evidence from Saturday Creek and other settlements suggests that investments were made to maintain a range of options, thereby providing flexibility and low-maintenance while reducing the risk of technological path dependence and economic sunk-cost effects.

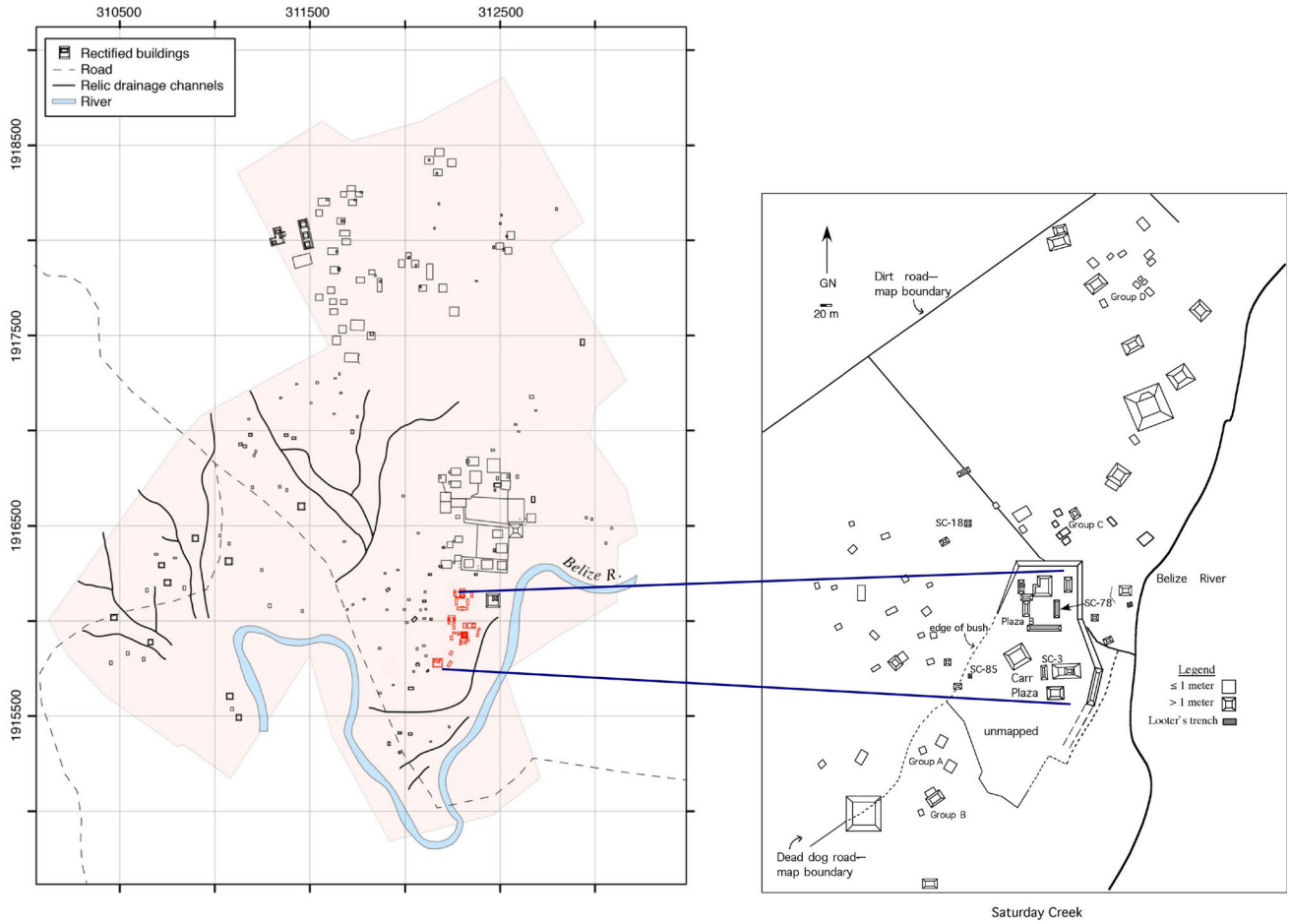


FIG. 3.12 Plan and overview of Saturday Creek, Belize. From Harrison-Buck et al., 2015, p. 300 (left; map prepared by S. Murata and M. Brouwer Burg) and p. 297 (right). Used with permission.

MANAGING RESOURCES: WATER, GARDENS, AND FORESTS

Water management was integral to the layout of the city. Grand plazas had broad plastered surfaces, spaces for hosting ballgames, market day activities associated with great pedestrian traffic, and large public ceremonies. But they were also water management catchments and drainages. Broad causeways, constructed with meters of fill and plastered surfaces, functioned as walkways for processions, but also controlled flooding events by serving as dams to divert water.

The Maya ultimately built sophisticated and well-engineered reservoir systems, epitomized by elevated convex macro-watershed systems in which reservoirs, dams, and canals were designed to capture and store water (Scarborough et al., 2012; Fig. 3.13). This system not only managed water quantity, it managed its quality as well: the system was designed to provide clean water. In constructing this system, the Maya mimicked nature. They engineered their reservoir systems as constructed wetland biospheres (Lucero et al., 2011). This was necessary in order to maintain water quality throughout the five-month dry season. Untreated standing water can become a breeding ground for water-borne diseases and the build-up of noxious toxins (e.g., too much nitrogen). To turn reservoirs into wetland biospheres, the Maya cultivated particular surface and subsurface plants that purified and denitrified stored standing water (Lucero et al., 2011, p. 483). An example of conservation is found at Cara Blanca, Belize: in this region, while the Maya built houses near lakes, they did not do so near cenotes, even though they contain water throughout the five-month dry season. By avoiding making fields and houses near cenotes, local flora and fauna were allowed to flourish, thus promoting biodiversity and conservation (Lucero et al., 2017). This case is not unique in the Maya area; any open area potentially has conservation elements.

The cycle of water-use did not end with drinking water; at Tikal managers released grey water from elevated reservoirs into bajo margin reservoirs and fields. With dense population in and near cities and porous bedrock, contamination from waste was surely a concern, especially during the annual drought when water quality was crucial. Because latrines and cemeteries are rarely found in cities, the Maya likely used night soil as fertilizer and buried most of their dead in peri-urban sectors, perhaps in areas that subsequently were cultivated (Lucero & Gonzalez Cruz, 2020, p. 11).

The Maya managed forests and promoted particular flora and fauna species (Ross, 2011). They cleared land to extract resources and intentionally burned patches of vegetation in controlled fires to replenish soils with pyrogenic carbon (biochar) as well as to accommodate hunting (Ford & Nigh, 2015). Forest management through land clearing, culling, promoting certain species, extracting resources, setting fires for hunting, etc. (Ford & Nigh, 2009), in addition to the use of diverse agricultural strategies, encouraged subsistence flexibility and long-term community investment in the landscape. Flora and faunal remains in the archaeological record show that even at the height of population size (ca. 600–800 CE), the residents at Tikal had access to forest products. Owing to the multiplicity and scale of combined landscape management practices, the Maya lowlands have been highly anthropogenic and diverse, and the practices that created these landscapes have endured: smallholder Maya communities still cultivate and maintain home gardens and fields that are rich in species diversity and mimic tropical forest ecosystems (Fedick, 2010; Lindsay, 2011).

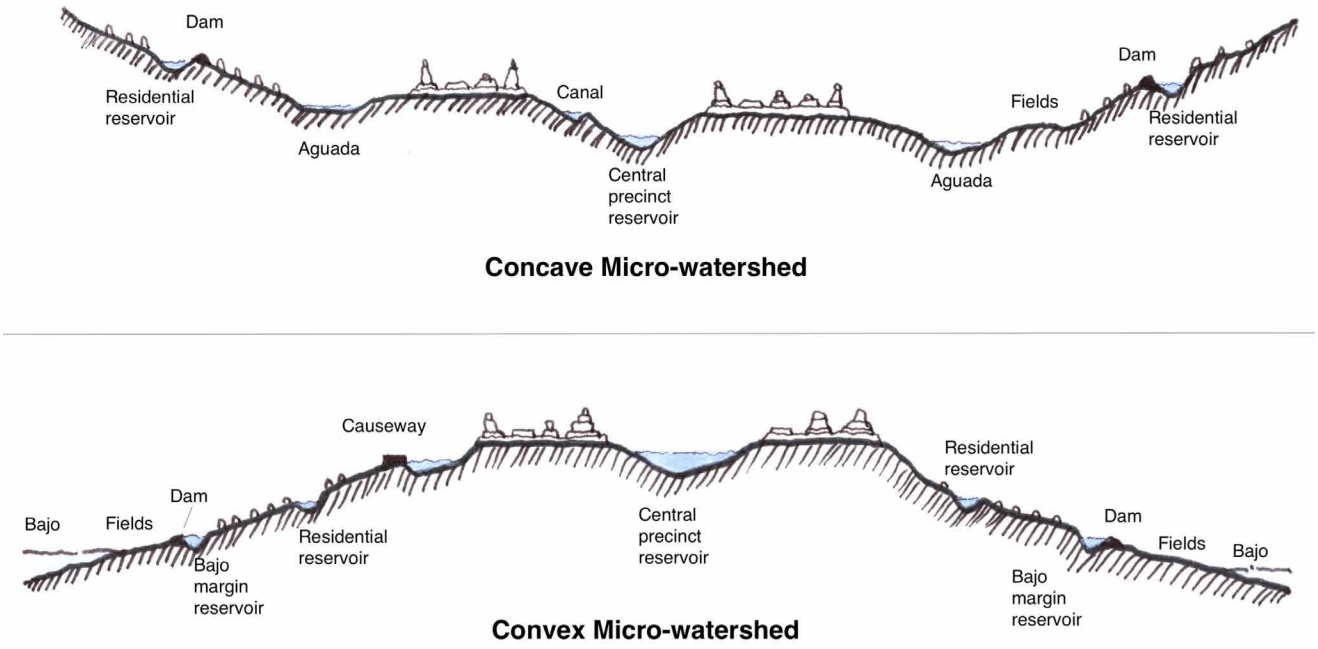


FIG. 3.13 Schematic of earliest (top) and later (bottom) reservoir systems. The later Classic period systems resulted in greater water management control and centralization of the resource. Image drawn by P. Ostovar from original provided courtesy of V.L. Scarborough.

A major feature of the regional urban order that the Maya created was the multi-functional use of water and agricultural systems (see Box "Managing Resources: Water, Gardens, and Forests"). Rainfall-dependency, relatively little perennial surface water, topography (e.g., entrenched rivers), and dispersed resources discouraged large-scale irrigation systems (Isendahl et al., 2019; Lucero, 2016). Instead, the Maya employed small-scale residential or community water systems by ca. 400 BCE (Scarborough, 1993, 2000; Wyatt, 2014), and began building centralized reservoirs probably by 300 BCE. Instead of maintaining large reserves of grain as non-tropical cities frequently did, the Maya emphasized large reservoirs for water; this was strongly driven by the area's high seasonal variability between the wet and dry seasons. The "still-water" reservoir system supplied water for drinking and hand irrigation with pots, for fish, reeds, edible snails and aquatic plants, and for waterfowl and game.

In later, Postclassic periods—separated from the Classic by complex processes of extended large-scale socio-political reorganization among major polities in the southern lowlands—cities were generally denser, but open spaces that could be used in urban agriculture prevail in city layouts. Many cities largely followed the same general urban layout and the same general pattern of growth, florescence, and decline as in the southern lowland heartland albeit with some variation and time lag. However, during the Postclassic there is evidence of transformation of the urban layout at a handful of sites. The best example is Mayapán on the northern coastal plain, where soils are relatively thin and precipitation low, but access to freshwater was consistent owing to the presence of *cenotes*. At its height of urban development ca. 1250–1450 CE, the city was different in several respects from the Classic period cities further south: residential buildings are much more densely placed and the core of the city, including residential areas, is surrounded by a city wall (Jones, 1957). While these features are distinct from the typical Classic city, unbuilt space in the walled sectors may have served as locations for urban gardening to form part of Mayapán's spatial fabric. Although this has yet to be confirmed, the discovery of apiculture implements at Mayapán (Paris et al., 2018) strongly suggests gardening; if so, the practice of urban food production was carried over into the Late Postclassic (ca. 1250–1450 CE) reconfiguration of Maya urban form.

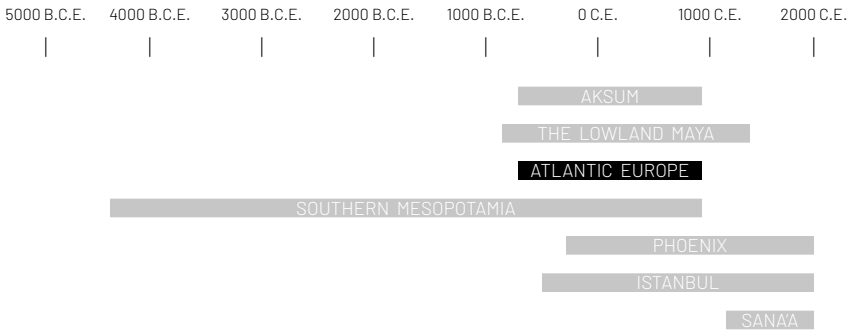
These changes in form were accompanied by a different political structure: sole kingship was replaced with a form of joint rule. The Maya not only abandoned the southern lowland centers, but also the political system, which was reshaped and re-formed for the new reality of northern, Postclassic life.

3.5 – **The Maya Lowlands as an Ancient Urban Laboratory**

Aspects of Maya culture history have been singled out as examples from the past of both sustainability and collapse. That informed and thought-provoking cases can be derived from these —seemingly contradictory—social phenomena, illustrates well the complexities and contradictions of comparisons across scales. To a large extent, Maya cities accommodated the environmental challenges of the region while exploiting and expanding the opportunities available in their individual settings to enable a measure of durability. During the Classic period, however, their increasing interdependence led to a condition that could not endure the environmental challenges that ensued. Path-dependent growth trajectories played a crucial role (Isendahl et al., 2014). "Path dependence connotes a sense of becoming increasingly stuck in a particular way of doing things, an inability to change even when change would be advantageous" (Nelson et al., 2014, p. 172). It is the antithesis of resilient strategies that maintain diversity of options and adaptive, flexible governance.

Despite—or, perhaps, because of—the dramatic reorganizations that characterize the Maya trajectory, we can see the Maya as an example of durability, within the centuries-long periods between reorganizations and across the whole Maya trajectory. However, the crucial issue is, of exactly what did the durable element consist? Although the Classic period cities eventually were abandoned, largely owing to competition among elites during a period of climate instability that led to resource over-exploitation and increased system vulnerability, we can still view them as profound success. Estimates are difficult to produce (Culbert & Rice, 1990), but it is believed that some 10 million ancestral Maya occupied the southern lowlands at 700 CE (Canuto et al., 2018; Scarborough & Burnside, 2010). This far exceeds what is supported by today's strategies: only one million people live in these areas now. Such a population disparity between past and present speaks legions about the durable practices, management skills, consumption patterns, and lifeways of an ancient tropical civilization, and points to what today's world might learn from past experiences of living durably in environments which are today considered marginal and fragile.

4 – Atlantic Europe



Atlantic Europe comprises the Atlantic-facing portions of Germany, France, Spain, and Portugal as well as Scandinavia and those insular areas that are today Ireland, England, Wales, and Scotland (Fig. 4.1). Also included are the many small islands scattered through the Atlantic and Baltic Seas. Over a period of about two thousand years this region saw the development of a rich and distinctive group of urban forms and associated political and social structures. Early urban forms were contemporaneous with, and similar to those in southern Europe, but subsequent settlement took on a more distributed and disaggregated form: urban functions were dispersed across landscapes and provided seasonal, public, and private activities. These dispersed systems of settlement fostered a flatter social structure that led to wider participation in civic life and decision-making in more broadly defined communities.

4.1 – **The Environmental Setting**

Northwestern Europe, Britain, and Scandinavia include regions of temperate and boreal climate that support livelihoods in agriculture, husbandry, hunting and fishing, forestry, and mining. Inhabitants could rely on rainfall agriculture, and plentiful wetlands and waterways provided additional economic and social resources.

These regions saw significant climatic shifts through time, driven in large part by volcanic activity. A long cool and rainy period lasted from the late Bronze Age (ca. 1200 BCE) until ca. 450 BCE, after which west European climate steadily became warmer and drier. The Roman Warm Period, as it is termed, persisted until the mid-400s CE. A period of wet and cold conditions followed, lasting in Europe and beyond until the 900s CE; the Nile River in Egypt froze in 829 CE (Lamb, 1977). Beginning in the 530s CE, intensive volcanic activity spewed particles into the atmosphere, sulphuric acid droplets obscuring the sun and causing extraordinarily cold summers all over the globe. Volcanic activity continued sporadically until ca. 660 CE (Büntgen et al., 2016). Agriculture and the food supply were disrupted in Europe and far beyond. Almost simultaneously (541–543 CE), the *Yersinia pestis* outbreak called the Justinian Plague raged in Europe and Scandinavia (Raoult et al., 2000). In some regions the massive death toll reached 50% of the population; the impact on commerce, labor pools, and every aspect of social life was immense. The term "Migration Period" is often used to describe this era, as people moved around, both locally and long-distance, in order to cope with conditions.

4.2 – **Archaeological Evidence: How Do We Know What We Know?**

Atlantic Europe has been investigated archaeologically for centuries. The forerunners of today's professional archaeologists were wealthy Europeans or clergy who, long before they ventured (often disastrously) into other world regions, investigated their own backyards. This kind of activity increased in the eighteenth century and the profession of archaeology emerged in the nineteenth century (Trigger, 2006). In the early to mid-twentieth century, economic conditions enabled huge excavations, sometimes revealing whole villages and towns. Environmental archaeology, which informs social, political, and ecological durability, was pioneered in Scandinavia: pollen analysis and geochemistry were invented there in the 1910s–1920s and soon spread to Germany; they were introduced into Britain in the 1930s by Grahame Clark after his visits to Sweden and Denmark in 1929 (Fagan, 2001). In the late nineteenth and early twentieth century, hot air balloons took the first aerial photos of Rome and Stonehenge. To these technologies and sciences are now added the many advances of recent decades. The discipline's significant time depth in the region and the resulting accumulated data have led to an enormous amount of archaeological, documentary, and environmental information about Europe's past, with constant additions and renewed interpretations.

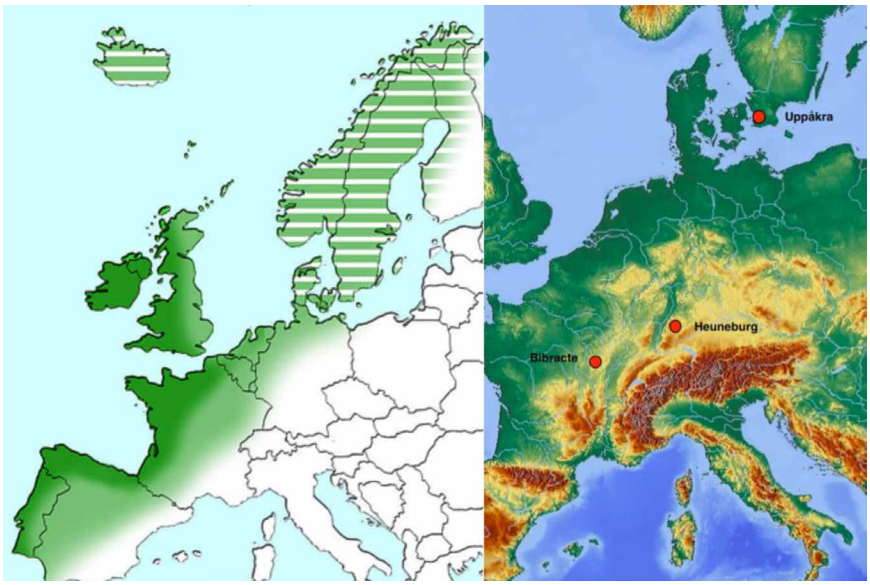


FIG. 4.1 Atlantic Europe (left), with some sites discussed in the text (right). Images courtesy of C. Potter and T.L. Thurston.

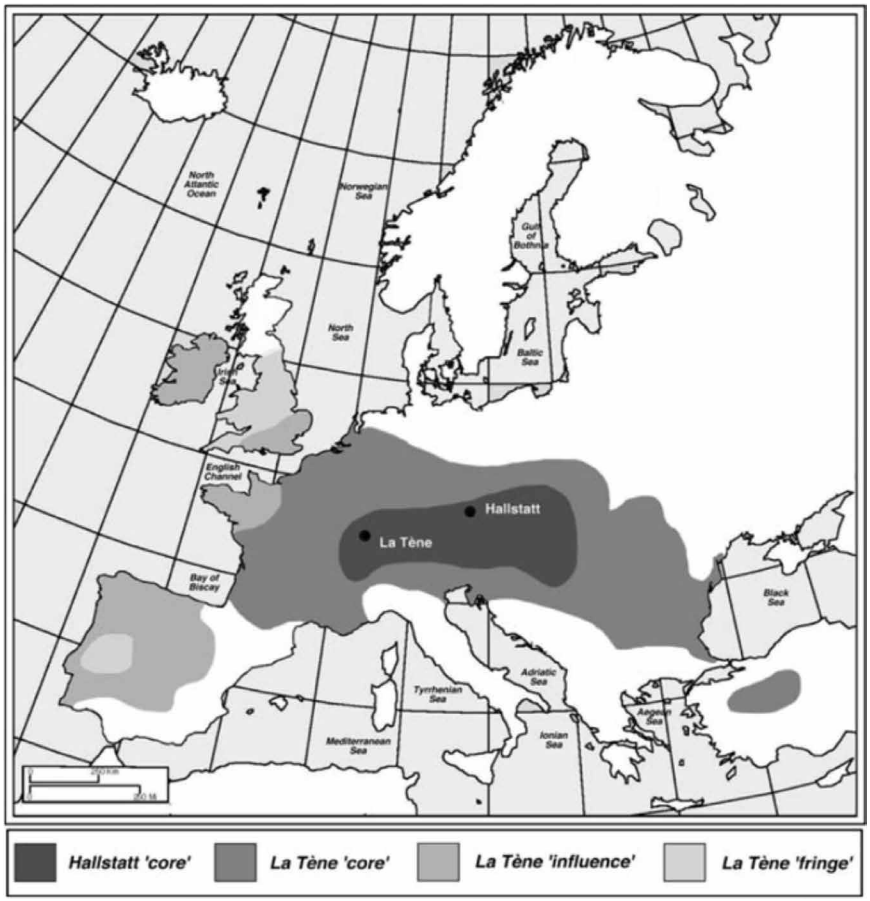


FIG. 4.2 La Tène and Hallstatt regions. Image courtesy of T.L. Thurston.

4.3 – **Overview: The Region through Time**

We explore almost two millennia, focusing on the first millennium BCE and the first millennium CE in the region. This long-term trajectory is here divided into four periods. The first two are in the first millennium BCE Iron Age (Fig. 4.2): The Hallstatt period (800–450 BCE) was followed by La Tène (450–52 BCE). The La Tène period ended with the Roman conquest and occupation of parts of the region; this directly impacted the occupied areas nearer Rome, while other areas (northern Germany, Scandinavia, Ireland, northern Scotland) were never conquered but their significant interaction with the Roman Empire resulted in profound impacts. The Roman period ended in the fifth century CE with the collapse of the Western Empire and was followed by a fourth period which encompasses Late Antiquity and the Early Middle Ages (or Migration Period, depending on the geographic context), which ended before the close of the first millennium CE.

Broadly speaking, urbanism in the earliest Hallstatt period was similar to that of other areas farther to the south in Europe. A distinctive continental strategy emerged in the subsequent La Tène period, characterized by urban functions distributed in both space and time; this not only allowed the successful environmental integration of rural and urban functions, but also reflected a less hierarchical societal and governmental structure. This strategy was altered by the Roman presence, but it was never eliminated. Social and spatial forms created in the later Iron Age remained foundational for many centuries after the Roman occupation ended, and distributed settlement remained widely characteristic across Europe until after WWII.

4.4 – **The Atlantic Europe Urban Form**

We focus on the four periods but remain mindful of the distinction between the Roman-occupied southern and the non-conquered northern areas. Our focus for the Roman period and subsequent Late Antiquity includes areas outside of Rome's occupation, which allows examination of the continuities that are found in these areas during and after the Roman presence further south.

4.4.1 – **The Iron Age Hallstatt Period (800–450 BCE)**

The first era of urbanization occurred on the European continent when the impetus for cities and towns was mainly to serve elites; it was based on a political system with its roots in the preceding late Bronze Age, when rulers seem to have had near absolute powers. Several waves of urban construction can be seen starting around 600 BCE. The earliest wave, during the Hallstatt period (800–450 BCE), saw the development of a type of urban site called Fürstensitze (princely seats) north of the Alps on the Danube and other rivers. Until the mid-twentieth century, it was believed that "barbarians" created such sites by imitating Roman urbanism but, when dates and construction sequences were clarified using radiocarbon dates, their development was found to parallel antique Mediterranean settlement: their first occupation occurred in the Bronze Age with urbanization following in the seventh century BCE (Fernández-Götz, 2018; Terrenato, 2015). These were fortified, strategically located, and often elevated centers of elite power (Fig. 4.3). Examples are Mont Lassois (France) and the Heuneburg (Germany; see Box "The Heuneburg"). Both the Heuneburg and Mont Lassois were centers of bronze production and hubs for long-distance trade (e.g., English tin, Baltic amber, and Mediterranean oil, wine, and prestige objects). Both had ritual and elite spaces inside of the main fortifications and towns of significant size below. A rupture of some kind ended this era, with many sites abandoned and signs of upheaval; the Heuneburg and other sites underwent one or more episodes of burning or destruction (Fernández-Götz, 2018, p. 127).

4.4.2 – **Urbanization in the Iron Age La Tène Period (450–52 BCE)**

By ca. 450 BCE several important changes had occurred, reconfiguring forms of both agglomeration and governance. Metallurgy in Europe had shifted from bronze manufacture, the components of which required long trade routes, to that of iron, which was readily available and could be mastered and commercialized by individuals. Elites, who had dominated the intercontinental trade in the components of bronze manufacture into the early Iron Age Hallstatt period, had lost much of their power.

THE HEUNEBURG

On a high mountain outcrop above the Danube, a massive bank and ditch enclosed a central citadel area, first constructed in the mid-late Bronze Age (ca. 1200 BCE; Fig. 4.3). By 600 BCE, it contained streets, large substantial houses and workshops. Many crafts were practiced at the site, and imports from distant areas reflect contact with the Greeks and their colonies. From this core area spread the rest of the town. A later second wall enclosed an area of over 100 hectares, comparable with Rome and other Italian cities of the same period (Terrenato, 2015). Between 5,000 to 10,000 people lived there, occupying separate fenced parcels with dwelling, storage and gardening areas; due to its large population, the city was also provisioned from the hinterland. Rich burials and other data suggest that this first wave of urbanization served a privileged class. The Heuneburg was among the many urban sites abandoned at this time (Fernández-Götz, 2018, p. 127).

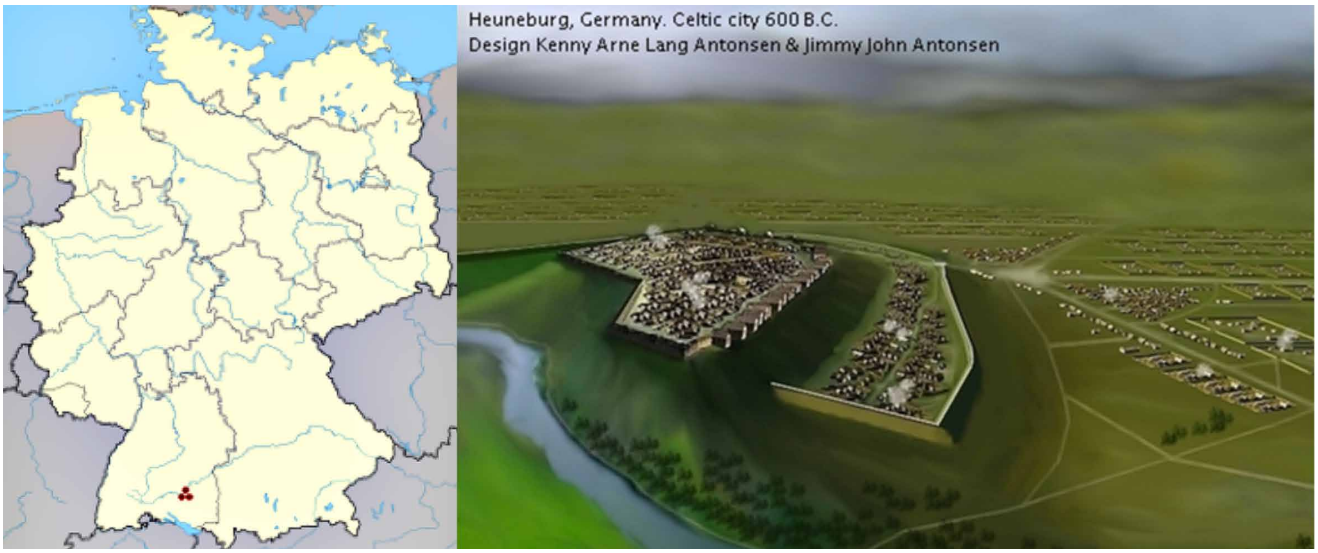


FIG. 4.3 The Heuneburg, location (within Germany; image by NordNordWest, CC BY-SA 3.0 DE, https://creativecommons.org/licenses/by-sa/3.0/de/deed.en, via Wikimedia Commons) and artist's reconstruction (image by Kenny Arne Lang Antonsen, CC BY-SA 4.0, https://creativecommons.org/licenses/by-sa/4.0, via Wikimedia Commons).

These changes led to a second phase of Iron Age urban activity, during a period termed La Tène, often associated with Celtic speaking peoples. New forms of agglomeration were established, markedly different from those of the earlier Fürstensitze and strikingly diverse from one region to another. One of these forms was the *oppidum* (pl. *oppida*), a Latin term for fortified towns, but even oppida varied widely in size, form, and function. This transformation had a strong levelling effect on Celtic social structure. There were planned migrations of Gaulish Celts to destinations as far away as Gordion (Turkey, 278 BCE). Trade with the Mediterranean world accelerated, new cities and towns sprang up on major rivers and routes.

This second wave of urbanization ushered in what appears to have been more egalitarian political systems, where more people had a role in decision-making for the polity, in both the urban area and its hinterland. In many instances, this later Iron Age urbanism took a distributed and disaggregated form in which functions of the city were dispersed in both space and time—a walled cosmopolitan town might house urban dwellers and contain an assembly place for political action, while a nearby but separate port handled its craftspeople and their market trade, and shrines or cult sites in the hinterland were foci for the region's religious activities, all supported by a rural population engaged in various kinds of production. Perhaps because of this distributed nature, the relationship between town and country seems to have been interpenetrating rather than distinct (Moore, 2017a).

4.4.3 – **Lasting Impacts on Settlement and Society**

Over the long term, when conditions were challenging, rural residents might flow in large numbers into the towns; in other times they headed in the other direction—absorbed into the hinterland when social, economic, or environmental conditions warranted. There may even have been significant local circular migration between villages and towns (Moore et al., 2013), in addition to the long-distance migrations that are a hallmark of the Iron Age (Fernández-Götz, 2020).

This flexibility both reflected and fostered a less stratified social structure, with fewer "all powerful" social actors and greater participation in civic life and decision-making across the wider community. The archaeological and textual evidence suggests that the La Tène Iron Age ushered in a social form commonly termed *heterarchical*, where several institutions—a body of legal authorities, a religious establishment, a military organization, and the popular assembly—each maintained equal or similar authority in their own spheres of influence (Crumley, 1976, 1995, 2001; Moore & González-Álvarez, 2021). This created "checks and balances" and encouraged negotiation among the institutions themselves and between leaders and followers, spreading social and political powers more horizontally. Some have suggested that the rupture observed in the examples of site destruction and burning in the Hallstatt period may mark the beginning of a transition at some sites from more hierarchical to more heterarchical forms of organization (Barrett, 1989; Giles, 2007; Hodos, 2009; Kristiansen, 2009; Moore, 2017a, 2017b; Moore & González-Álvarez, 2021; Oubiña, 2003; Thurston, 2016).

GENDER IN CELTIC AND GERMANIC SOCIETY

The growth of gender archaeology since the late twentieth century continues to produce many studies of Celtic and Germanic gender roles and identities that combine archaeological, bioarchaeological, and textual data to offer surprising insights on health and wellbeing across social classes, and reveal a large range of social roles for women and men signaled by mortuary treatments, iconography, and texts (Hadley, 2008; Pope & Ralston, 2012; Robb et al., 2001; Solli, 1999, 2008), as well as significant social roles for people of alternate or ambiguous gender (Price, 2004; Raninen, 2008). Classical authors and modern scholars are in agreement that both Germanic and Celtic women had significantly more legal and social rights than those in Rome (Clover, 1993; Crumley, 1974; Plutarch, 2008; Tacitus, 2009). Elite women were present in many public roles in religion and politics (Fig. 4.4): female religious specialists reached the highest levels of social prestige (Aannestad & Glørstad, 2017; Knüsel, 2002) and there were also less-elite religious specialists (Gardela, 2008; Nasstrom, 2000; Price, 2004). Some female elite warriors bore all the implements and signifiers of commanders (Hedenstierna-Jonson et al., 2017; Price et al., 2019) and ordinary women were frequently combatants in warfare (Redfern, 2008; Simniškytė, 2007), interred with weapons and bearing combat wounds, as was described by classical authors (Plutarch, 2008; Tacitus, 2009). Women political leaders and rulers are also known (Arnold, 1995; Hingley & Unwin, 2006). Both elite and commoner women were active in farming and craft production.

In terms of general wellbeing, generalization is difficult but a study of 51 women in a British Iron Age cemetery revealed that 15% of mid-life skeletal remains showed evidence of multiple violent episodes, with injury locations similar to prehistoric North American women. These may relate to the injuries of active combatants, passive victims of raids and attacks, or female to female violence. Out of the 51, three women displayed injuries consistent with domestic abuse, matching contemporary injury profiles. Research in Iron Age Italy (Robb et al., 2001) suggests that while rich and poor alike had adequate nutrition and similar health status, elite males—even those buried with weapons—had few injuries, while those of the lower classes showed evidence of both hard labor and violent or warfare encounters. Women of all classes, higher and lower, displayed the same evidence of work-related physical stress. Overall, these insights on gender are not inconsistent with both the egalitarian and the asymmetrical aspects of the Iron Age.

FIG. 4.4 Perhaps the richest Viking Age grave ever found, the Oseberg Ship Burial contained the remains of two women, one now interpreted as a priestess. The grave lay beneath a large memorial mound in Norway, and dates to around 830 CE. In addition to rich furnishings and magical paraphernalia, the elaborately carved ceremonial cart was decorated with images of cats, sacred to Freya. A tapestry buried with the ship depicts women and men performing sacred rituals and processions. Left: Public Domain. Right: "The Oseberg Procession Tapestry (Best Viewed Large)" by A. Davey, CC BY-NC-ND 2.0, https://creativecommons.org/licenses/by-nd-nc/2.0/jp/?ref=openverse.

One manifestation of this more horizontal organization was in the practice of agriculture, and in the institutions of property ownership within which it took place. The Scandinavian "*vång*" field system arose during this period. Each family possessed a strip of three different terrain types: clay soil, sandy soil, and scrub pasture—keeping everyone's assets equal, and providing a variety of contexts for livelihood. Similarly, the Dutch cope-system showcases the more egalitarian practice of balancing soil condition (peat) and governance structure: the width of the parcel was determined by the curvature of the groundwater table and the length by the optimal size for feeding a family and paying taxes. The analysis of long timespans in the study of property boundaries can reveal formative and dynamic processes (Løvschal, 2020).

The tradition of "the commons" developed to supplement individual farmsteads, showing that smallholders were able to manage common property with fairness and skill (Netting, 1993; Ostrom, 1990). In this way they combined agricultural and pastoral production, exploited forest products, and harvested wetland resources. The entire community thus shared responsibility for maintaining landesque capital, which is the investment of labor to improve land for both the present and the future (Håkansson & Widgren, 2014). This constitutes a closed system of resource re-use and circularity, such as the fertilization of anthropogenic agricultural soils with manure, construction of soil drainage systems and earthen enclosures, and the management of local natural resources.

Heterarchical organization is reflected in other aspects of society. Possibly as a result of the widespread manifestation of this more democratic form, gender relations in later Iron Age Europe seem to have been less asymmetrical, in contrast with Greek and Roman societies (see Box "Gender in Celtic and Germanic Society").

The functional and organizational diversity of oppida and entrepôts across La Tène Europe in the second half of the first millennium BCE points to diverse approaches to providing the population with cultural, educational, commercial, religious and other urban functions (Fernández-Götz, 2020). Enclosures that were exclusively commercial workshops, pilgrimage destinations, ports along rivers, and animal pens all appear in the archaeological record for the period. While many large towns emerged, there are few signs of elites or rulers dwelling within them. At sites like Titelberg (Luxembourg) and Gournay-sur-Aronde (France) there is archaeological evidence for temporary structures, erected and deconstructed over and over, that appear to have been used for voting (Fernández-Götz, 2014, p. 113; Fernández-Götz & Roymans, 2015, p. 20). Julius Caesar's accounts align with this: while war leaders and civic leaders could propose major "projects", final decisions about community actions were often put to a general vote from the populace, although who exactly was eligible to vote is unclear. Other Roman accounts describe assemblies where thousands of people gathered to make such decisions. One of these assembly areas was located at Bibracte (Figs 4.5 and 4.6), the seat of the Aeduan Gaulish (French Celtic) polity (see Box "Bibracte (La Tène)"). Because they were an important trade partner with Rome, considerable information regarding Aeduan social and political organization can be derived from Classical documents (Crumley, 1987).

BIBRACTE (LA TÈNE)

The oppidum of Bibracte (France), founded before 200 BCE, is among the most important sites of the late La Tène period (Figs 4.5 and 4.6). Intensively studied since the nineteenth century, it hosts a multi-disciplinary European Iron Age research program and the Museum of Celtic Civilization. The site benefits from both archaeological and textual information, although the latter (especially Julius Caesar's Commentaries on the Gaulish War) requires critical evaluation.

Situated on one of the peaks of the Morvan mountain range in western Burgundy, Bibracte stood at a commercial crossroads between the Celtic world and Rome. Waterways offered the fastest travel, and Bibracte's location above the three largest river basins in France (the Saône, Loire, and Yonne/Seine Rivers) meant that great quantities of products passed through this territory. The polity, called the Aedui, installed a system of customs that taxed these products, making them middlemen in trade between the Mediterranean and northern Europe.

Excavation at Bibracte has revealed a neighborhood of artisans' lodgings and the workshops of blacksmiths, bronzeworkers, enamellers, goldsmiths, and minters of coins. Mines for the extraction of metals, including gold, iron, and tin ore were nearby. The Aedui minted their own coins between the third century BCE and 50 BCE. At first the currency was minted from gold, but by 120 BCE they began minting silver coinage tied to the Roman denarius. As is the case for several large sites (e.g., Heuneburg), new technologies have revealed the site to be much larger than was previously thought, and thus have increased estimates of its population, which for Bibracte range between 5,000 and 30,000 (Maschner, 1996).

Aeduan druids had important religious, educational, ambassadorial, and juridic functions. At the summit of the mountain, a great place of worship (nemeton, or sacred grove) was surrounded by a palisade and concentric ditches. The Aeduan political system had an elected senate; druidic sanctions restrained elite aspirations, preventing individuals or families from seeking hegemony. A supreme magistrate (vergobret), elected annually, had sole responsibility for the administration of Aeduan territory, and he could not leave it during his tenure.

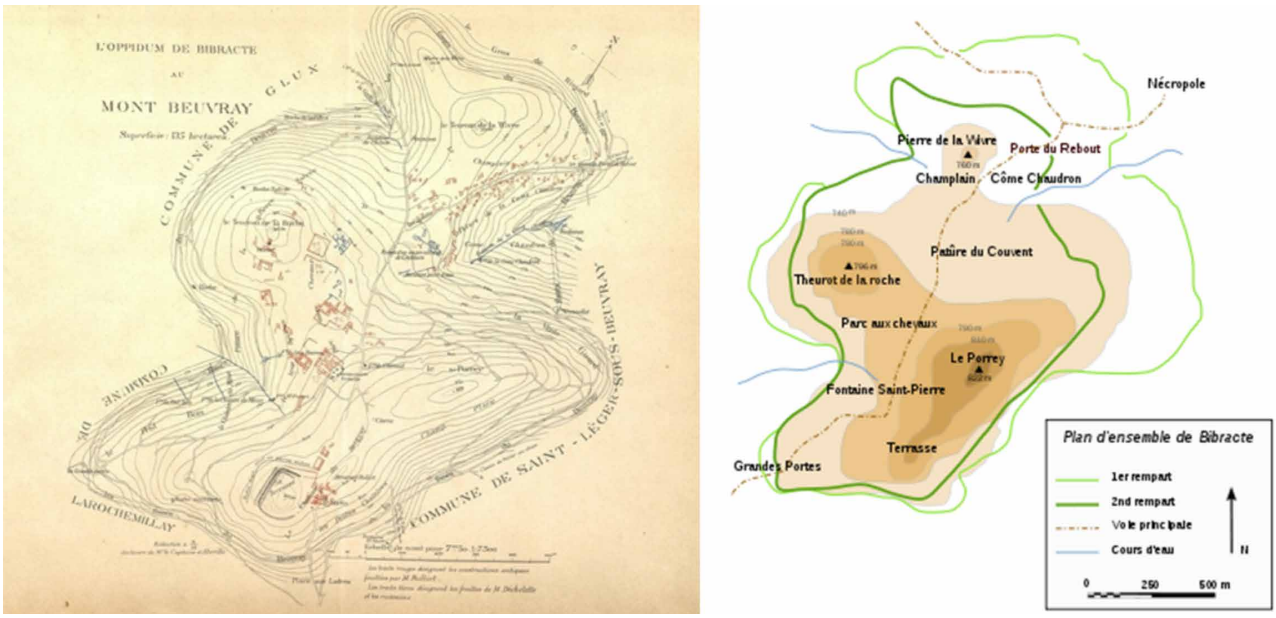


FIG. 4.5 Map of Mont Beuvray (left; Déchelette, 1903), and plan of the oppidum of Bibracte (right; image by Bashar, CC BY-SA 3.0, http://creativecommons.org/licenses/by-sa/3.0/, via Wikimedia Commons).

FIG. 4.6 Artist's reconstruction and photo of the *murus gallicus* of Bibracte. Photo © Bibracte, by Antoine Maillier 2011 / n° 87664. Both images used courtesy of the Bibracte Iconotheque.

4.4.4 – **Roman Occupation (52 BCE – Fifth Century CE)**

During the first century BCE Rome conquered and colonized large parts of the Celtic-speaking regions; areas that were previously independent fell under the direct control of Rome (see Box "Bibracte, Autun, and Rome"; Fig. 4.7). This ushered in a period of Roman urban planning imposed on some older sites and the development of some new centers, but much of the countryside retained previous forms of social, economic, and religious traditions and settlement.

Roman agriculture has long been admired and was particularly interesting to eigtheenth century elites who venerated the world of Graeco-Roman antiquity. Early American presidents read Tacitus' *Agricola* and other works in Latin and Greek and sought to apply their principles. But Roman practice in their newly acquired provinces was not as admirable: in order to reduce costs and maximize yields, they eschewed Celtic practices such as manuring fields and controlling erosion. Many regions, including Burgundy, were forced into mono-cropping wheat, needed by the Roman Empire to feed slaves and the poor in cities; timber and metals were taken for shipbuilding. These tactics are recorded in the geomorphology of the Arroux Valley, where the Roman era is characterized by several meters of eroded sediment (Straffin & Blum, 2002). As the climate became more erratic in the later third century CE, peasants abandoned farmland due to high taxes and low yields.

Other areas, some Celtic-speaking and some Germanic-speaking, lay outside of Rome's direct control. These were heavily influenced by Rome, but remained independent, and could retain more of the settlement characteristics and durable strategies that they had established in previous times. During the La Tène period, the Germanic regions to the northeast of Celtic speaking La Tène lands saw a socio-political system that was in many ways parallel to the La Tène. Urbanization had a similar character, though urbanized places were generally later and smaller further north. A good example is the site of Uppåkra in southern Sweden (Fig. 4.8; see Box "Uppåkra").

At Uppåkra and similar sites, the compounds of elites with both military and religious affiliations drew population until they contained several hundred to several thousand people (Skre, 2008). The institution of the assembly was also in effect at multiple scales, with regular local and district meeting places in the country. As towns developed, urban assemblies were formed and eventually, by the so-called early medieval "Viking Age", there was a "national" level assembly where rulers (kings) were elected. Thus the assembly form can be traced across most of Iron Age Europe, for while local ways of life and societal organization could be dissimilar, other practices reflected shared traditions over great distances (Pantos & Semple, 2004; Semple & Sanmark, 2013).

BIBRACTE, AUTUN, AND ROME

As early as 121 BCE, due to their strategic position and their broad trade networks in Gaul, the Roman senate made the Aedui *amici Romae*, "friends of Rome". But less than a century later, the relationship had changed: Rome was growing in power and ambition and the Aeduan faction opposed to Roman domination had grown. Late in the Gallic Wars, the Aedui renounced their long-term allegiance to Rome and joined the resistance to Roman expansion. In 52 BCE the sacred grove atop Bibracte hosted the election of Vercingetorix, an Arverni nobleman, as leader of the combined Gallic armies. The Gallic resistance lost to Caesar that year at the battle of Alésia. Following this, Caesar wintered at Bibracte and began writing his Commentaries.

Because of their privileged status with Rome, Caesar treated the Aedui mercifully after his victory. Under the Emperor Augustus, the Aedui became a *civitas foederata* ("allied community") and their capital was moved from mountainous Bibracte to a riverside site, the new capital at Augustodunum (present-day Autun). The relocated Aedui adapted to the realities and opportunities of Roman rule. In 48 BCE, the Aedui were the first Gallic polity to provide senators for Rome. By the third century CE Greek merchants had introduced Christianity; Autun was the first bishopric outside of Rome (ca. third century CE) and was the center of the early power of the Church in Gaul.

Augustodunum's architecture and layout reflects its Romanized nature (Fig. 4.7); there were at least two theatres and an amphitheater which seated 17,000 spectators, fine residences, many shrines and temples, an imposing city wall and several gates (most of which may be seen today). The arts and urban life flourished and Aeduan elites quickly turned themselves into Gallo-Romans, as evidenced by the blended names on elaborate funerary stelae and the city's evolving religious life.

FIG. 4.7 The gate (left) and theater (right) at Augustodunum (Autun). The Saint-André gate is one of four Roman entrances into the city, situated at the cardinal points. Two remain complete and are still in use (image in the public domain, https://commons.wikimedia.org/wiki/File:Autun_porte_Saint-Andr%C3%A9.JPG). The Roman theater was built in the first century CE during the reign of Augustus. It is the largest in France, with seating for 1500 spectators. Just outside the city walls exists another theatre, of similar size and age (image in the public domain, https://commons.wikimedia.org/wiki/File:Th%C3%A9%C3%A2tre_romain_Autun.JPG).

UPPÅKRA

Uppåkra, in today's southern Sweden (Fig. 4.8), was founded around 100 BCE and reached its height in the fifth to sixth centuries CE, continuing into the eleventh century. Following the dissolution of a hierarchical, stratified Bronze Age society, the Early Iron Age (500 BCE – 1 CE) reveals a densely packed but "egalitarian" landscape (Magnusson Staaf, 2003) with self-supporting homesteads and few signs of authority. Low-profile, consensus-based leadership rather than an aristocracy is suggested, with equally weighted public voting assemblies. In following centuries, interactions with Roman and continental powers spurred a re-emergence of militaristic elites with growing wealth. During this time, Uppåkra emerged as a chiefly center and developed into the largest currently-known town in Iron Age Scandinavia, perhaps home to an early regional king. A square kilometer harbored a succession of large elite residences and many skilled craftspeople, surrounded by up to 50 agglomerated farms. In the third century CE, a temple or "cult house" appeared, yielding hundreds of gold objects and a figure of Odin, it's enclosure containing heaps of weapons, precious metals, and human and animal sacrificial offerings—the latter resulting from ritual feasts. The site was abruptly abandoned in the eleventh century as Denmark's royal authority was established over the region and Uppåkra's rulers lost power. Despite this, the powerful voting assembly long persisted, providing a durable interdependence across social classes and groups. The site's 1000 year longevity owed little to stability in elite political forms, but much to fluid rural–urban organization, facilitating survival through periods of tremendous social and ecological flux: a political and religious center intentionally controlled by distributed governance in what Scott (1977) called the "moral economy" that mediates between ordinary people and their leaders.

FIG. 4.8 The cult house at Uppåkra reconstructed. Map courtesy of T.L. Thurston. Image by Sven Rosborn, CC BY-SA 3.0, http://creativecommons.org/licenses/by-sa/3.0/, via Wikimedia Commons.

4.4.5 – **After Rome: Late Antiquity/Middle Ages**

The enduring distribution of urban functions across space and time was an expression of the flexible European settlement tradition. Even after the move to Augustodunum/Autun, Bibracte was not entirely abandoned. It retained some of its earlier functions, which included veneration at sacred springs and commercial activities evidenced by horse-corrals and tradesmen's booths. The last of the old fairs on Bibracte took place in the early twentieth century. Great early commodity fairs were organized across medieval Europe, moving east and north toward Russia as Europe urbanized in the later Middle Ages. Their organization and governance were separate from those of towns near which they were held; instead the "peace of the fair" was ensured by fairground police and judges (Allix, 1922).

Another example of the endurance of practices was that of peripatetic rulership and legal jurisprudence: rulers and courts of law traveled from place to place to meet with the populace and negotiate and adjudicate issues and disputes (Arnold, 1997; Roach, 2013). This is in strong contrast to the earlier Hallstatt period, when leaders seem to have been firmly situated in urban places and were characterized by displays of wealth and power. The more horizontal organization of the La Tène era fostered the expectation that leaders and rulers would be responsive to their constituents. In the face of upturns and downturns in climate and environment crosscutting social institutions were created that inspired cooperation and supported a kind of resilience.

The ability to shift from the cereal farming imposed by the Roman state back to traditional mixed and pastoral farming practices in the post-Roman period, as demonstrated from plant remains, was another key to long-term success for both rural and urban settlements. In response to Mediterranean urban demand and a warmer climate, wheat replaced heartier grains like spelt and barley in the La Tène period. Centuries later, as the climate worsened in the later Roman and Migration periods, the population returned to more durable grains (Tickner, 2008).

Cities that endured employed flexible strategies to survive both political and climatic upheaval, notably the catastrophic periods of volcanism, widespread flooding, failed harvests, and pestilence (Haldon et al., 2018; Jones, 2000; Little, 2001; Peregrine, 2020) of the long Medieval period (ca. 500–1500 CE). They retained or recovered flexible strategies to survive both political and climatic upheaval, including catastrophic periods of volcanism, bitter cold, failed harvests, population movements, and pestilence. In many ways, the long Medieval period relied on strategies and landscape templates that were in place by the later Iron Age (Crumley, 1994; Tejerizo-García & Carvajal Castro, 2021). The indigenous system of interdependent and cooperative organization also facilitated continuity of the region's social and cultural traditions; this allowed society to emerge from the turmoil of Roman collapse, albeit changed, over the course of the Middle Ages.

4.5 – **Atlantic Europe as an Ancient Urban Laboratory**

Northwest Europe, Scandinavia, and Eurasia provide a two-millennium record of a settlement strategy that calls into question the more familiar urban–rural distinction. While initially on a trajectory similar to areas to the south, major environmental, economic, and social changes combined to move Atlantic Europe toward a different system. A strategy that distributed the functions of cities across space (the landscape) and time (the calendar) was buttressed by horizontal relationships formed through strong trade and collective labor associations.

From at least the middle of the first millennium BCE, considerable archaeological and historical evidence of social equity is inscribed on the landscape: representative voting in the assembly traditions of Celtic and Germanic peoples, the Carolingian and Anglo-Saxon movable court-of-law systems, and many others. Despite periodic efforts by elites to standardize and subjugate rural societies, a significant portion of the population was also able to resist. In many regions, more equitable societies were able to withstand the imposition of medieval serfdom and debt servitude.

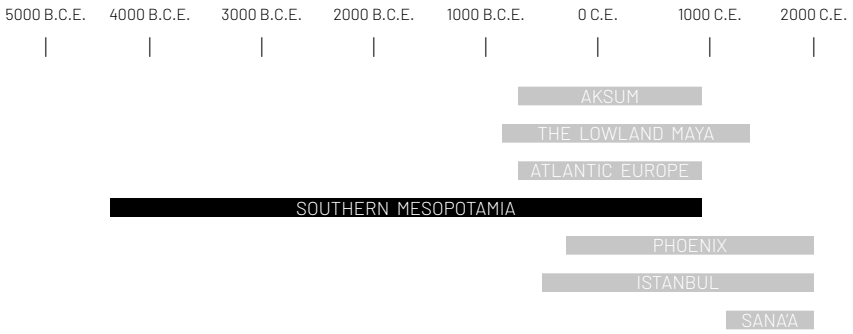
Across Atlantic Europe these patterns continued until after WWII, and in some regions of the continent they continue today; city life is not for everyone. Now, however, the adoption of corporate agriculture, the disappearance of rural services, and the lure of cities have reduced the rural population in many areas of the world, leading to the widespread economic and social collapse of rural communities. New approaches to durable cities and food production must include the physical and social regeneration of the countryside.

Over the last three millennia in Europe, an interesting pattern has recurred. After major disruptions such as wars, changing climate, infectious disease, or the collapse of state power, the countryside accommodated those who fled great cities and devastated lands. Rural networks of towns and villages were more democratic than cities, and repopulation of the countryside stabilized society. In northwest Europe, Iceland, Scandinavia, and Eurasia rural networks fostered values we today appreciate as democratic, such as representational voting, women's and minorities' civil rights, and the welcoming of newcomers across ethnic lines. While periodic efforts were made to subjugate rural areas, a significant portion of the rural population was able to reconfigure more equitable societies.

This pattern is not unique to Europe (Fletcher, 2019; Scott, 2008, 2009, 2017; Sulas & Pikirayi, 2020) and the form and its benefits have continued well into contemporary times. In Europe this vision persists, kept alive in part by a widespread nostalgic view of rural life. The pattern could still be seen even after the industrial revolution. By the later nineteenth century European rural residents were well-connected by rail to many villages and towns. But even before railroads, populations were—contrary to received wisdom—remarkably mobile. In many parts of the world, a web of services, in both permanent and fleeting locations, still connect rural people. Specialized market, manufacturing, and educational towns, seasonal fairs, and social and religious events offer the amenities of cities while supporting a less-dense pattern of settlement that, in the future, could accommodate new forms of agriculture and more local and participatory forms of governance.

These rural webs can still be found today in temperate, arid, and tropical biomes, suggesting a fundamental human settlement pattern that offers adaptive flexibility in times of urban systems' uncertain resources and disintegrating social fabric.

5 – Southern Mesopotamia



Mesopotamia is the land "between the rivers", lying between the modern Tigris and Euphrates. Cities appear earlier than 4000 BCE, and the area is intensely populated continuously until the Islamic period nearly 5,000 years later. This extremely long time-depth of urban settlement in Mesopotamia provides an extensive record of experiments in urban durability.

5.1 – **The Environmental Setting**

Southern Mesopotamia is a semiarid alluvial plain, with winter temperatures sometimes falling below 0 degrees C (32 degrees F), summer temperatures exceeding 40 degrees C (104 degrees F), little rainfall, and periodic large-scale flooding (Fig. 5.1). The overall landscape can be described as a mosaic of different microenvironments: areas suitable for agriculture and pasture, substantial reed-filled marshes as well as dunes, and small seasonal waterlogged swamps.

Unsurprisingly, over the course of the region's 5,000-year history, this environment and its landscape changed. The Tigris and the Euphrates were originally one river; some time prior to the fifth millennium BCE, this singular Tigris-Euphrates River split into the two rivers we know today. Over the next several thousand years, the Euphrates and its major branches moved west, splitting and rejoining as they did. At the same time, as the Tigris River moved east across the plains it remained largely a singular branch with few substantive primary branches. These processes played out over long time scales, punctuated by abrupt and sudden changes such as river avulsions that cut off water from key river branches. These processes could be part of longer-term hydrological changes: for example, the movement of the Euphrates to the west led to the gradual cessation of water in eastern branches, as identified in the archaeological record around the site of Tell ed-Der (see An Heyvaert & Baeteman, 2008). Or change might be abrupt, such as the shift in the course of the main channel of the Euphrates in the second millennium BCE, which directed flow to the west and cut off water to the central portion of the plains. Recent high-resolution satellite imagery reveals the remains of layers of ancient looping meanders and relict levees of both rivers, cycles of change over time recorded in the palimpsest landscape (Adams, 1981; Hritz, 2010; Hritz & Wilkinson, 2006).

These major and minor shifts in the river system were accompanied by other related changes, including the expansion and contraction of ephemeral seasonal and permanent marshes as well as forested areas, and the retreat and advancement of the gulf shoreline over time. Synthesis of multi-proxy regional climate datasets (Wilkinson, 2003) indicates that the Holocene climate was prone to fluctuations that shaped dynamic conditions in the microenvironments of southern Iraq.

After a period of intense cold and dry conditions in the Younger Dryas (10,780–9,480 BCE), southern Mesopotamia entered a trajectory of warming and drying, punctuated by swinging extremes such as the 8.2 BP event or during the ninth to tenth centuries CE—a short and intense cold snap, with snow in the Baghdad area—and a particularly hot and dry period at the end of the third millennium BCE (Fig. 5.2). New multi-proxy sampling (Altaweel et al., 2019) indicates that a period of pronounced and sustained climatic drying during the fifth and fourth millennia BCE coincided with the beginning of the urban trajectory, which has continued to the present day.

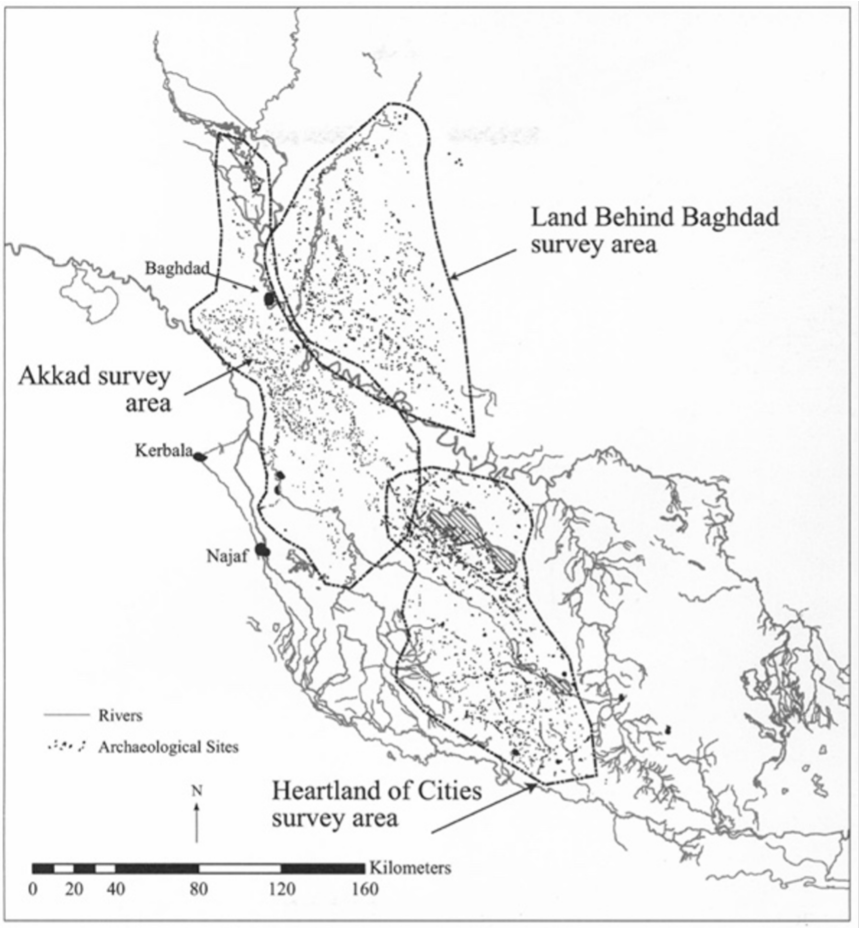


FIG. 5.1 Map of southern Mesopotamia (Hritz, 2010). Used with permission.

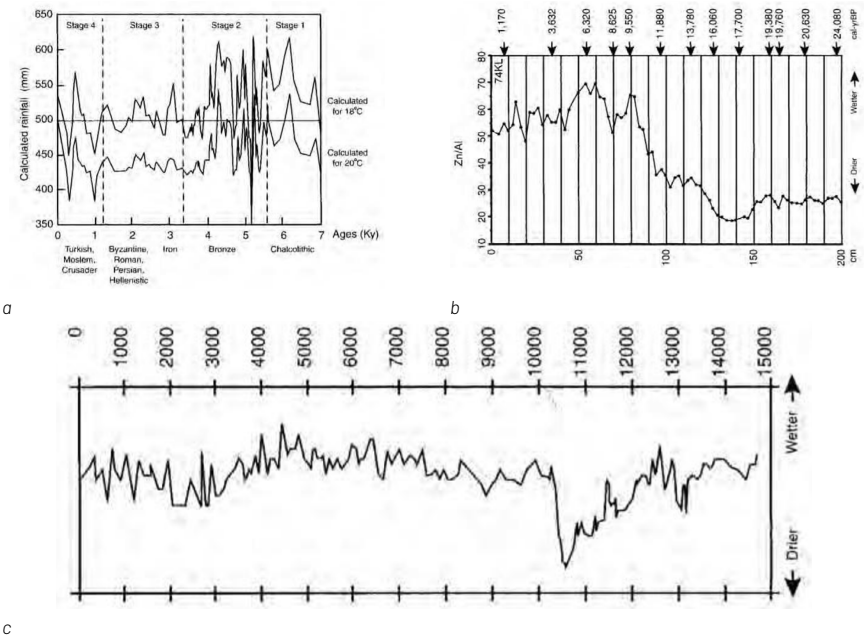


FIG. 5.2 Climate proxy records from (a) Soreq Cave, Israel (modified from Bar-Matthews et al., 1993, Fig. 9.5); (b) Lake Van, Turkey (modified from Lemcke & Sturm, 1997, Fig. 5); (c) the Indian Ocean (modified from Sirocko, 1996, Fig. 4e). Note that the time scales are in (a) uncalibrated years B.P. (at 1,000 year intervals), (b) calendar years, and (c) calibrated years B.P. Figure and caption from Wilkinson, 2003, p. 20. Used with permission.

5.2 – **Archaeological Evidence: How Do We Know What We Know?**

The rich archaeological and historical records of southern Mesopotamia, the region between the city of Baghdad in the north and the Gulf shoreline in the south, give us a deep and spatially extensive landscape-scale record of the environment during this process and of the ways that humans lived within it. This record includes large and small archaeological sites: utilitarian construction such as storehouses and water management structures, ritual and ceremonial structures such as temples and ziggurats, traces in the ecology and soil chemistry of areas that were put to different uses such as agriculture and pastoralism, and significant monumental sculptures. Additionally, the administrative nature of the Mesopotamian state created a writing system, and left extensive archives that include bureaucratic records, law texts, and literary works.

However, the time scale is vast, and our window into this deep time is limited. Small residential houses, mudbrick and reed dams, and other ephemeral structures likely characterize areas outside of the inner city and have left little trace in the archaeological record. Natural processes such as erosion and sedimentation, cultural processes such as changes in socio-political and economic conditions, the reuse of built environmental features and the limitations of still evolving archaeological survey and excavation techniques, have left us with what are in effect snapshots of changing urbanscapes. Different time periods, scales, and locations throughout the alluvial plains are revealed by these datasets. These snapshots tell us that there is no single template for urbanscape or city in Mesopotamian history; rather, variation is the norm.

5.3 – **Overview: The Region through Time**

This region was the arena for a long and dense history, with small and large polities rising and falling over centuries, enacting cycles of political expansion followed by contraction, of centralization followed by dispersal; there were periods of maximization and focus on particular strategies, and there periods of generalism and "casting a wide net" (Adams, 1978). These were the products of the interaction of a series of factors such as climatic shifts, socio-political and economic changes, and technological innovations. However, while overall change through time is significant during the *longue durée* of Mesopotamian history, it occurred incrementally and over time. Abrupt changes, such as massive shifts in settlement locations, are rare.

The earliest settlements seem to have been located at the far south of the alluvial plains in the delta of the Tigris and Euphrates rivers where today they converge to form the Shatt al-Arab waterway and spill into the Gulf. During the period of climatic drying in the fifth and fourth millennia BCE there was a transition to larger and more dense settlements; located in the southwestern portions of the plains, these were dispersed along the edges of the presumed gulf and the Euphrates. The large Haur al-Hammar marshes dominated the landscape.

During the early third millennium BCE, settlements shifted to the north and spread out along the rivers and their primary branches, creating the pattern that has been described as pearls along a chain. Larger urban clusters of cities and their hinterlands developed throughout the Mesopotamian plains; sites such as Uruk/Warka reached a walled size of 450 ha. Ancient texts reveal that intensive and extensive irrigation agricultural activities dominated the economy, with significant organized animal husbandry and fishing. This period of hyper growth, integration, and centralization—political, economic, and social—was followed in the subsequent latter third and second millennia BCE by a period of fragmentation, decentralization, conflict, and population movements. These processes are most evident in the decline of settlement numbers and sizes, and the abandonment of settlements in the central portion of the plains associated with river channel movements.

During the first millennium BCE and into part of the first millennium CE, southern Mesopotamia experienced unprecedented agrarian growth, with population densities and city building integrated into successive powerful and heterogeneous regional empires including the Sassanian and Islamic. The fertile alluvial plains were occupied intensely until the Islamic period. The end of these six millennia of successes was marked by the accumulation of failures within key sectors of the irrigation agricultural system, most notably in failing to provide for canal and field maintenance—Adams's (1981) classic volume is still the best source for more information on this process.

5.4 – **The Mesopotamian Urban Form**

The Mesopotamian city and urbanscape flourished across all periods. While cities in southern Mesopotamia were diverse in terms of populations and activities, some generalizations about the common and enduring division of space and built features can be made across time periods. In southern Mesopotamia, traffic moved along river channels and canals that linked cities and towns throughout the urban system. A few features characterized Mesopotamian urbanscapes: palace and temple complexes, a port or harbor, orchards or gardens along canals and channels, sprawling suburbs of residential structures, and a walled inner city (see Kültepe-Kanesh for example of suburbs (Özgüç, 1963) or Tell Taya (Curtis, 1982)). One would pass through these areas of sprawling suburbs where most animals were kept and agricultural fields and orchards were located, perhaps traversing riverbanks lined with date palms and gardens that provided food, shade and riverbank stability, or along streets leading to the gates of the walled inner city.

Water management in the arid but flood-prone environment was paramount, and the topographical positioning of cities/towns was intentional and strategic. Levees—long dikes or artificial flood banks—allowed control of the volatile river water. Towns were positioned on the crests of levees, which permitted them to take advantage of fertile soils and access to water. Agricultural fields were placed on the levee back slopes (for more information on the presence of seasonal swamps and wetlands around sites, see Brandt, 1990; Wilkinson, 1990). On the flat drainage lands beneath the levee were seasonal swamps and wetlands. Sampling from sites and

their environs has begun to demonstrate the deep time presence of these marshes and their importance for resources and subsistence (Hritz, 2010; Hritz et al., 2012). The result was a system where water flowed from top to bottom while being treated along its path and put to multiple uses (Fig. 5.3).

Inner cities were characterized by different functional sectors. For example, the religious sector was dominated by at least one large temple and sometimes with a multi-level ziqqurat that was visible for great distances in the relatively flat alluvial landscape. Other sectors were divided by streets and in some cases, such as at Nippur (Fig. 5.4; see Box "Nippur"), by channels/canals. There were educational (schools), industrial, administrative, and residential sectors with the latter identified by one or two story houses comprised of rooms around a central courtyard (Algaze, 2008; Van De Mieroop, 1997). As they entered the inner city through monumental gates and proceeded to the temple sector, most people would have continued into the large courtyards at the base of the temple; there and in buildings surrounding the temple(s) exchange and religious activities—notably offerings to the gods—might take place. Approaching and entering the sanctuary would have been reserved for a religious class (such as priests and priestesses) that maintained the sanctuary and directed religious activities; they would have lived in nearby quarters.

The remainder of the inner-city around the temples and religious core, comprised of different areas of production, commerce, record keeping, education, and administration. Historic texts record the presence of open green space for orchards and gardens within the city (Cocquerillat, 1968). Mesopotamian cities were large, but population levels in the inner city are unclear (Adams, 1981; Postgate, 1994; see also Algaze, 2018 for a recent study that discusses poor health conditions in ancient Mesopotamian cities).

In all types of public as well as domestic buildings, the primary building material was mudbrick (Fig. 5.5). Clay was omnipresent in alluvial southern Mesopotamia. Mixed with straw/chaff as temper, it made for a cheap and durable building material that could be produced quickly and in large quantities, though it did require maintenance to endure. Clay also provided plaster that made walls more resilient. In areas that were exposed to soil humidity, baked bricks that could withstand the destructive force of water were used. While more durable than mudbrick, they were considerably more expensive, as they required fuel for their preparation and firing. Bitumen was the only easily available caulking material for drains and pavements. Flat roofs were constructed with imported timber and reed mats covered with thick layers of mud plaster. If a building became dilapidated, the roof beams would be salvaged and reused in new buildings. Vaulted roofs (barrel and corbel vaults) provided a low-cost alternative to timber roof construction since they could be constructed entirely from locally available building materials. Further south, at the edges of the marshes where they grew, reeds were more extensively used as building materials. This tradition of building structures with reeds has been studied ethnographically (Thesiger, 2007) and continues to the present day at the edges of the drying Haur al-Hammar marshes (Hritz, 2010). Careful attention to the care of these structures was and is critical to their durability and rate of decay.

Mesopotamian dwellings had to insulate against temperature extremes, which over the course of 24 hours could be significant (Adams, 1981, pp. 3–11). Houses usually were built around inner courtyards with no outside windows. During summer air vents that could be opened and closed as needed for ventilation. Courtyards often had partially covered areas (alcoves, comparable to *iwans* in Islamic houses) that offered refuge against the greatest heat of the day while providing adequate ventilation. Mudbrick walls have very low heat conductivity, providing good insulation against both summer heat and winter cold. Reed mats provided an excellent material for temporary structures (awnings, canopies), protecting against the sun and sandstorms while allowing air to circulate. The absence of nearby forests in southern Mesopotamia meant that wood for fuel was in short supply. The only local resources to burn were brushes, shrubs, and animal dung. The latter seems to have been the major source for heating and cooking within houses.

This template of the Mesopotamian city and its urban landscape evolved through time from as early as the fifth millennium BCE, as the remains of temples and other structures uncovered at the site of Eridu show. Textual records and archaeological material from the late fourth and early third millennium BCE at sites such as Nippur, Uruk, Girsu, Umma, and Lagash reveal the beginning or reoccurrence of a pattern of Mesopotamian city features wherein urban centers had differentiated component sectors, with small sites having specialized activities in the surrounding landscape (Van De Mieroop, 1997). By the first peak of centralized bureaucracy in the latter third millennium BCE, the picture that emerges and endures is one of a landscape of similarly organized urban centers and supporting surrounding subsistence settlements.

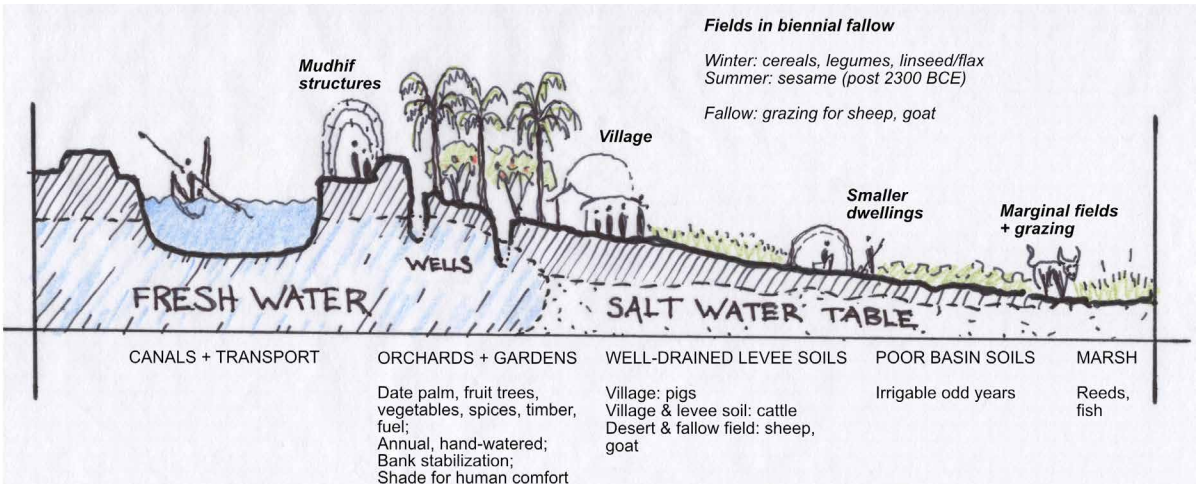


FIG. 5.3 Mesopotamian canal and levee section drawn by P. Ostovar and adapted from Postgate 1992, Fig. 9.1. Vertical scale is exaggerated.

NIPPUR

About 90 miles southwest of Baghdad in the central portion of the southern Mesopotamian plain is one of the largest archaeological sites in the region: the city of Nippur (Fig. 5.4). The site today occupies over a square mile, with remains mounded up to 18 m (Gibson, 1992). In antiquity, it was bisected by a major canal drawing from the Euphrates River, allowing travel to the site by boat. Nippur's massive size reflects at least 6000 years of nearly continuous occupation, beginning perhaps as far back as the fifth millennium BCE. The site is located at the nexus of three micro-biomes/environments: the fertile agricultural plains, the semiarid desert of the central plains, and the seasonal swamps that were once located off the backslopes of the river levees (Adams, 1981; Brandt, 1990; Gibson, 1980). Nippur relied on taxation and interactions with its hinterland for basic flow of goods and people; in any given period it might be surrounded by small settlements in agricultural fields, with pastoralists exploiting land that was marginal for agriculture (Pollock, 1999; Postgate, 1992; Yoffee, 1995). Primarily a religious center, the city weathered local and regional geopolitical changes, conflict, and profound changes to the environment. Texts and archives provide snapshots of conditions as the city changed through time.

Nippur is a particularly rich source for this information. The long preserved archaeological and textual history of the site enables us to see how the landscape and environment changed at both long and short time-scales. As long-term changes in the river systems' courses took place, small-scale adjustments in the canal system could compensate for changes in water availability, provided that socio-political conditions were amenable. However, abrupt breaks could occur. At Nippur, we see such disruption in an intimate way from the excavations and texts at an Old Babylonian period house (1750–1300 BCE). Texts from this house describe it as the property of a family of bakers who worked on contract for the city administration, the temples, and other individuals (Gibson et al., 1978). Spatial analysis of objects from the house reveals that the interior space was used as an office and shop while exterior space was for production. Objects left on the floors and the overlaying stratigraphy of dune formation indicated an abrupt abandonment of the house. Survey (Adams, 1981) and contemporary excavations (e.g., Gasche et al., 1998) demonstrated a major shift in the western branches of the Euphrates at this time. Sites along its western course and in the central plains would have been starved of reliable access to water for irrigation and consumption. At around the same time that the bakers left their shop in Nippur, other abandonments at Nippur and at nearby cities such as Ur, Larsa, and Isin were also taking place.

After a lengthy period of abandonment, Nippur was reoccupied under the control of a new dynasty of foreign rulers; buildings were reconstructed and new ones were added. The reoccupation of the Nippur can be attributed to several interacting factors: its location at the nexus of multiple resource niches (irrigation from the Euphrates and its branches, productive agricultural land, seasonal swamps at the base of levee backslopes that attract fish and fowl, and access to pastoral corridors to the west) and ideological and cultural significance as a long-standing religious center. This reorganization proved a powerful symbol of legitimacy for presumed foreign Kassite kings, who even built a palace at the site. Larger and more elaborate buildings and houses were built on existing foundations. Water was brought back to the site—and others in the central plains—via new, highly engineered canal systems. Unlike the natural and hybrid canal systems of earlier periods which followed the natural topography of the plains, these canals cut across topography, requiring more sophisticated planning and maintenance. These new technologies and management practices reflect a fundamental shift in the socio-environmental system of southern Mesopotamia.

FIG. 5.4 Plan of Nippur, with excavation areas indicated. Tablet Hill is the mound with Trenches TA, TB, and TC. Used with permission from the University of Chicago, Oriental Institute.

UR IN THE LATE THIRD MILLENNIUM (UR III PERIOD 2112–2004 BCE)

Ur in the late third millennium BCE had become a complex place. The need to manage labor, keep track of production, and collect revenue and taxes in an ever more complex urban setting led early on to the development of accounting tools and bureaucratic procedures, and eventually to the development of writing around 3000 BCE (Schmandt-Besserat, 1996). Writing with reed styluses on clay tablets was employed in administrative contexts, but also for commemoration and propaganda, notably royal inscriptions and historiographic texts (Cooper, 2016). The ability to record and store information cheaply and efficiently and transmit it over long distances was instrumental in the development and successful maintenance of the larger territorial states that characterized southern Mesopotamia beginning ca. 2350 BCE (Steinkeller, 1993); at its zenith the Neo-Assyrian Empire extended from Egypt to central Iran (Postgate, 1979).

The first of these well-documented bureaucracies encompassed the period of 2122–2004 BCE and is referred to as the Ur III period, after the ruling dynasty's capital at the city of Ur (Fig. 5.5). Ur or Tell Muqayyar was located in the far southern reaches of the alluvial plains, perhaps along the ancient coastline of the Persian Gulf. An abundance of surviving ancient texts from the Ur III period document the development, evolution, and end of the territorial polity/empire, which had its center at the city of Ur, with secondary centers at Nippur, Girsu, Umma, and Uruk. At Ur itself, decades of excavations have uncovered a 50-ha site, which contains the large ziqqurat of the King Ur-Nammu, the court of Nanna, the giparu or official dwelling of the Nanna priestess (Weadock, 1975), and the city wall (Fig. 5.6). Archaeological evidence for other components of the site layout is unclear due to widespread destruction and rebuilding at the site in later periods, but texts indicate that the site was divided into neighborhoods and possibly contained two harbors for ship docking from the gulf. Thousands of administrative texts document the geography of the state, the importance of different cities such as Nippur, the development of law codes, political organization, and military activities. Texts document all aspects of socio-economic management including irrigation systems and agriculture.

The ability to maximize administrative responsibility and accountability, however, could result in over-bureaucratized systems that choked the economy and showed little if any adaptability to changing conditions. One of the kings of the Ur III state, Shulgi (2029–1982 BCE), attempted to create an overall redistributive taxation system (bala system) in which the provinces of the state could withdraw provisions from various distribution centers, essentially eliminating local markets and individual entrepreneurship (Sharlach, 2004; Steinkeller, 1987). The system, however, proved to be too rigid to adjust to changing environmental conditions. Over-irrigation of fields resulted in soil salinization, and appropriation of crop fallow to make up for shortfalls in agricultural production caused loss of fertility, leading to widespread famines and social and economic instability. The administrative and economic rigidity and inflexibility of the Ur III system weakened the political and military potential of the state, ultimately contributing to its collapse (Civil, 1987; Jacobsen, 1982). Subsequent political structures avoided this degree of state intervention into the economy, allowing for greater resilience and faster responses in times of crisis (Adams, 1978).

FIG. 5.5 Ur. Image by M. Lubinski, CC BY-SA 2.0 https://creativecommons.org/ licenses/by-sa/2.0, via Wikimedia Commons.

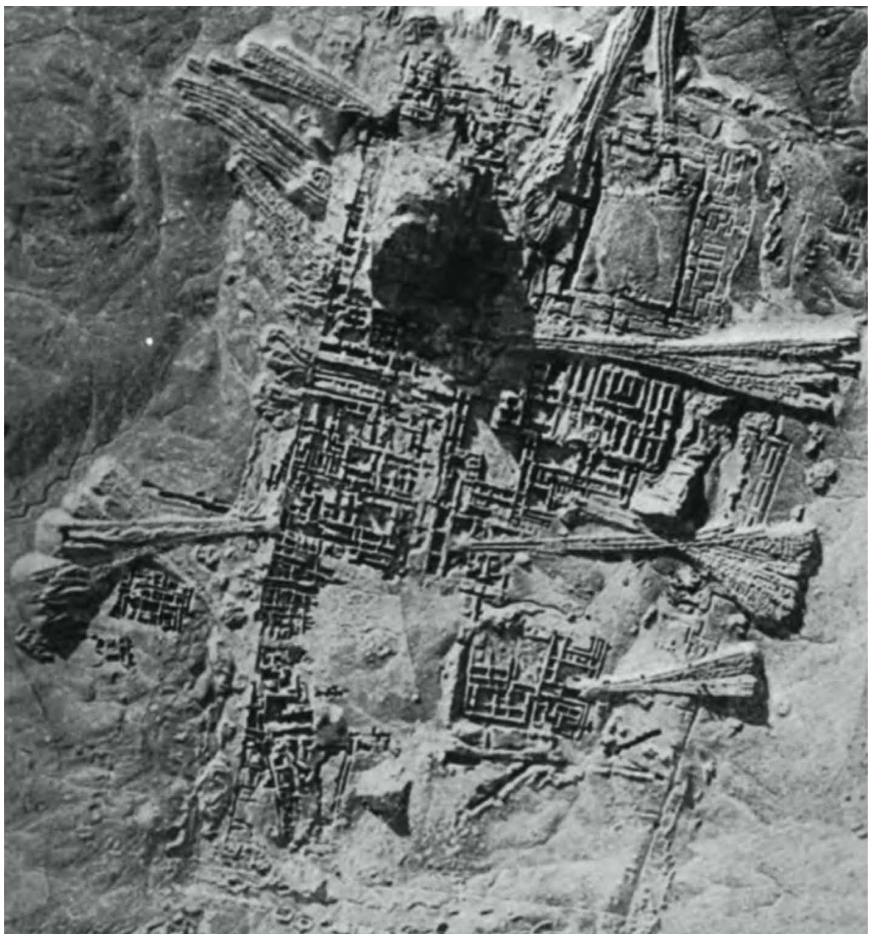


FIG. 5.6 Ur from the air (circa 1922). Photo Royal Air Force official, Public domain, via Wikimedia Commons.

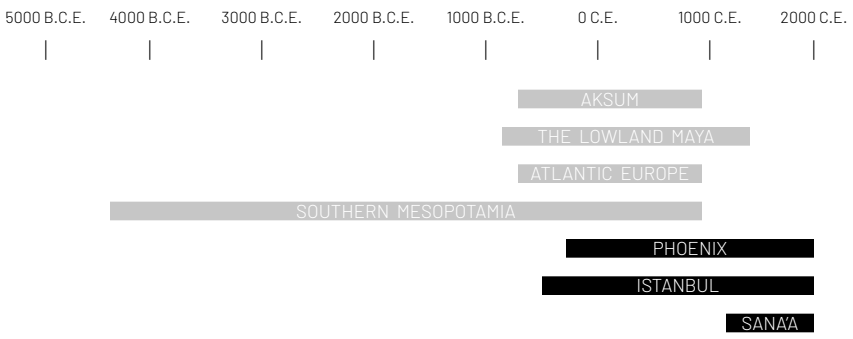
5.5 – **Southern Mesopotamia as an Ancient Urban Laboratory**

Ancient Mesopotamian cities and their urban landscapes demonstrate regional durability, the importance of flexibility and diversification of resources, and the socio-cultural significance of place over millennial time-scales. They also demonstrate the value of long records of human/environment interactions and the importance of the complex human and environmental variables that contribute to a city's vulnerability and adaptive capacity. This dispersed landscape gave rise to elaborate systems of organization. These varied from bottom-up local organization led by irrigation managers or local governors reporting to centralized states, to the top-down organization, administration, and engineering of the cities and their landscapes. The latter was most prominent in the Assyrian heartland and under the empires of the later historic periods.

We can view this long history as a succession of experiments in settlement organization and resource management under changing conditions, and as strategies for responding to new challenges. Many such strategies were used:

- Changing from nucleated to dispersed settlement patterns: extensive archaeological surveys (e.g., Adams, 1981) demonstrate the cycles of nucleation and dispersion of settlements patterns from the fifth millennium BCE onward.
- Construction of new canals to open new areas for agriculture: texts, particularly those dating to the Ur III period, describe canal construction and maintenance and evolving labor practices (see Box "Ur in the Late Third Millennium (Ur III Period 2112–2004 BCE").
- Changes in the proportion of barley (which is more salt-tolerant) to wheat crops; three examples of these shifts have been described (Jacobsen & Adams, 1958) in mid-third millennium BCE, thirteenth century BCE, and more recently during the Islamic period ca. 1200 CE. Specifically, texts from the site of Telloh or Girsu record land surveyors' descriptions of patches of saline fields and declining crop yields.
- Shift in ratios of subsistence activities to include emphasis on labor.
- Periods of pastoralism and use of marsh resources.
- Further elaboration of institutions and law codes, e.g., Urnammu and Hammurapi (Roth et al., 1995), that addressed shifting access to resources.
- Changes in the technology of managing canals and channels (from natural to hybrid to entirely artificial).
- Changing configurations of space in different cities and shifts in site locations, as some sites were abandoned in favor of new locations.

6 – Living Durably: Where the Past Has Become the Present



For most of our discussion we have excluded contemporary examples, that is cities that may have had a very long history, but which are still occupied and thus are not "archaeological" in the common sense of the term. Aksum, which is today quite large with respect to other towns in the region, is an exception, but our focus was mainly on its archaeological component. For many reasons, we believe that the archaeological record offers a rich font of knowledge about human life over long time scales, and that much of this knowledge is unavailable from any other source. This uniqueness is made more important by a number of practical concerns. Most prominent is the rampant destruction of the world's archaeological heritage and the loss of this knowledge forever. More prosaically, archaeological research competes for funding with other research activities.

The past does not "end" at some point in time after which we are willfully blind, and there is no hard line between a city that has ceased to be occupied and thus is of primary interest to an archaeologist and a city that is still occupied. Archaeologists work in cities that continue to thrive, and with anthropologists, historians, ecologists, and other researchers they examine the material culture of a place and people, revealing views of the city that complement those achieved in abandoned cities through traditional archaeological techniques like excavation. One approach reveals a long-term trajectory, the other an historical slice. To illustrate this and to complement our purely archaeological examples, we present here a small selection of examples of cities that still endure. The first is the modern city of Phoenix, Arizona, and its prehistoric antecedents; the second is the modern city of Istanbul, and its antecedents dating back to its founding by the Greeks; and the third is an overview of several small but remarkable cities that have found elegant techniques for flourishing in harsh and arid deserts for centuries.

6.1 – **A City Where a City Was: The Sonoran Desert, USA**

Sometime in the later part of the first millennium BCE, a farming community developed along two rivers that flowed westward out of the mountains of what is today the state of New Mexico. The Salt and Gila Rivers crossed what is now Arizona, eventually merging and then flowing to the Colorado and from there south to the Gulf of California. The region was hot and dry; what little rain fell—about 300 mm per year—came mostly in late summer monsoons, with the other parts of the year seeing almost no precipitation for months. Small-scale irrigation agriculture had been practiced in the region for a thousand years, but the engineering expertise and social organization during this period of florescence turned large ditches into extensive canal systems (Fig. 6.1). Water from these rivers was diverted into channels more than 10 m across, and these flowed away from their sources, following contour lines that curved first away from the rivers and then parallel to them. Some of these canals reached 40 km in length, and the plains that they watered became fertile fields that the farmers tended for more than ten centuries. The population of the area grew into the tens of thousands.

We know that the population grew and shrank through time, often in response to climatic shifts and changes in the political and social contexts of the relationships between this area and the places around it. A striking transformation occurred around 1150 CE with the reorganization of villages. Archaeologists see a change in the way houses and towns were built: one style of architecture and village layout was replaced with another (Fig. 6.2). A more dramatic change occurred in the 1300s CE, when something caused the area to be depopulated and perhaps even abandoned. The cause is unclear, but it is likely a part of widespread changes across the whole of the American Southwest. The canals fell into disuse and decay. At the time of the arrival of Europeans, the valley was hot and dry; the few Europeans who came there found it to be inconvenient if not inhospitable.

FIG. 6.1 A view looking along the path of one of the main Hohokam canals leading northwest from the Salt River. Image courtesy of J.T. Murphy.

FIG. 6.2 Reconstructions of pithouse (left) and Pueblo-style (right) houses at Pueblo Grande Museum, Phoenix, Arizona. Images courtesy of J.T. Murphy.

If the story ended there, it would fit nicely into our archaeological framework; it would easily provide fodder for an analysis of the kind that we have presented here—why the community persisted through various shifts in climate and water availability, why the reorganization might have happened, and why eventually the very durable structure that had existed for over a millennium eventually was insufficient, or insufficiently attractive, to be maintained. We would look at its beginning, middle, and end, and gather what lessons we could.

But the story does not end there, and we present it here for a different purpose. In the middle of the nineteenth century CE, a very different political and social context emerged: specifically, a market in and around this region for agricultural products, especially cotton. And it was in this context that an entrepreneur named Jack Swilling looked at the area and saw not an inhospitable desert but a farm. He could see this fairly clearly: the canals were still there, 10 m gashes whose purpose was easy to understand, though filled with sediment and no longer connected to the shifting riverbeds. The fields, having been tended for centuries, were still there and with little effort could again grow crops. Even those pieces of the old canal infrastructure that were not directly usable provided a plan for how the whole system once worked and could work again.

Usable canals were cleaned, and new ones were dug; farms received water (this time with pumps), and towns were established. One of those towns was in search of a name; "Pumpkinville" was proposed in honor of one of the crops being grown. Wiser heads prevailed, and another name was used: the town, rising from the "ashes" of the previous occupation, was to be called Phoenix.

We have seen this phenomenon before, at Nippur, for example, where a city abandoned becomes a city rebuilt. One of the salient parts of the example in Phoenix is that the "city-ness" of Phoenix endured even when all of the actors changed. What constituted the city was an infrastructure, a larger context in which the city existed, and a series of flows: population, resources, light, but especially water. When all of those flows were balanced, the city persisted; when some aspect of the conditions changed, the city responded, with minor modifications—continual adjustments and maintenance on the canals—or with major transformation, like the twelfth century reorganization. When things were ultimately too far out of balance, the city was paused. But when the context was again conducive, pieces of what had been there were available to be used again.

The context, this time, was to change dramatically. For about 100 years Phoenix was a comparatively small farming community, one of several that sprang up along the rivers and canals. But that all began to change in the 1950's. We will pick up this story in another chapter, when we look at existing cities and the challenges they are facing today.

6.2 – **An Enduring City: Istanbul**

Founded by Greeks in 667 BCE as Byzantion after its mythic founder, the city was renamed Constantinople as the capital of Imperial Rome in the fourth century CE, and in the early twentieth century became Istanbul. With its strategic commercial and military location at the straits between the Black Sea and the Sea of Marmara, the city links the east European interior with the Mediterranean and Europe with Asia.

The city's influence greatly increased when the Roman emperor Constantine chose it to be the capital of the Eastern Empire, transforming the earlier city into an elegant and wealthy magnet whose population rose to 400,000. The collapse of trade (especially grain), after the Arabs seized Egypt, Palestine, and Syria in 640 CE, required a major re-organization of the city's food supply system from the Nile Valley to the more proximate regions of Thrachea and Thessaly. Furthermore, an adaptive capacity for urban and peri-urban agriculture emerged, responding dynamically to cuts in regional supply lines, e.g., in times of violent conflict (Barthel & Isendahl, 2013). Lacking a good source of freshwater near the city, aqueducts were extended to distant sources that fed a large-scale system of cisterns for freshwater security. Constantinople was famed for its massive and complex defenses. Constantine erected the first city wall, which protected the city on both land and sea. This and successive walls protected the city, its cisterns, and space for growing food. The apogee of the antique city occurred during the reign of Justinian in the sixth century CE, when the population reached 500,000, the Christian presence increased, and churches and monasteries multiplied.

FIG. 6.3 Fishing on the bridge over the Golden Horn in Istanbul with a view towards the old city of Constantinople. Image courtesy of S. Barthel.

From the mid-fifth century to the early thirteenth century, Constantinople was the largest and wealthiest city in Europe. Despite many sieges and plagues, dramatic changes in governance and religion, a disastrous fire in 1197, and the sack of the city in 1204 by the Fourth Crusade, the walls kept medieval Constantinople relatively safe. Finally, cut off from key resources (security, food, water), the city fell to the Ottoman Empire in 1453 CE. Even then, the Ottoman victors began rebuilding the infrastructure immediately.

Constantinople has endured many catastrophes and, over the long-term, life in the city can hardly be termed serene. Nonetheless, its many rulers have, for the most part, taken care to attract inhabitants, not least by ensuring supplies of food and water, and by maintaining the security of the city. When long distance grain deliveries were interrupted, the areas between the many city walls were used to grow fruits and vegetables and provide meat and eggs to supplement marine resources (Fig. 6.3). When local water supplies were insufficient for the growing population the aqueducts were extended, and the city walls protected the cisterns that stored water for use during droughts and frequent sieges.

Today, Istanbul is home to fifteen million people and is one of the 25 largest cities in the world. Lessons from this very long-lived city are these: (1) maintain *diversity of resources* at every possible level (e.g., many fruit trees, many large and small producers, many production strategies). (2) remain *flexible in fulfilling needs* (e.g., find new water sources and devise a protection for stored water), and (3) *invest in infrastructure* that has multiple uses (e.g., many walls secure the city as well as its water supply and agricultural space).

We can consider Istanbul and Phoenix in light of the question of how archaeology shapes our work. Both are extant contemporary cities; both are heavily shaped by their pasts. But the cities of today look dramatically different from the way they looked a millennium or two ago. One implication of this is that our understanding of the long-term trajectory of both places is revealed fully only through a collection of lines of evidence, of which archaeology is a key part. In Phoenix, archaeology is one of the only windows into those past times; in Istanbul there are historical documents, but these are of limited value in understanding the long-term trajectory in the way we wish to know it. We readily acknowledge that other disciplines play a role, from ecology and history to climate sciences and hydrology; nonetheless, archaeology remains a key analytical component.

6.3 – **Desert Spaces**

There is one other strategy we can use to understand alternative ways that cities function in the past: there are some places that, unlike Phoenix and Istanbul, are little changed from earlier times. These may be the real "success stories": places that have not rocketed into modernity like the sprawling metropoles of Phoenix and Istanbul, but which instead remain remarkably unchanged. These cities are still in the process of enduring, and they provide a window into older ways of life that complements archaeology. What an archaeologist could learn from the ruins of an older city is augmented by studying living cities with the same forms.

This is not to be taken too far: many cities in the archaeological record do not have close analogs to existing cities, so the approach is limited, and there is an importance to seeing not only the beginnings and the middles of cities' stories, but also their ends, which is why "archaeological" cities are of immense interest. Moreover, we cannot assume that life several millennia ago was actually like life now, even if the buildings are in the same arrangement. People can be remarkably creative in changing their social worlds, and while this is generally reflected in the physical worlds they inhabit, an archaeologist will not necessarily assume that the two have to change in complete concert.

Nevertheless, walking through a city that is still occupied is immensely valuable. We choose here to reflect on the character of ancient cities in hot, dry climates, or, simply, desert cities. We note that this example may prove especially relevant because future climates are projected to become drier in many regions; desert cities may become more common.

A typical way that cities adapt to hot and dry environments is to become denser, and to do so in specific ways that provide for a way of life that is both comfortable and efficient. Schonauer (2000) identified several key components of this form of densification. These include two notable strategies. The first is the use of small precincts for residential neighborhoods; this creates areas without through traffic, forming a compact urban development pattern with no wasted space, and puts many community facilities within reasonable walking distance and with the population density required for efficient mass transportation systems.

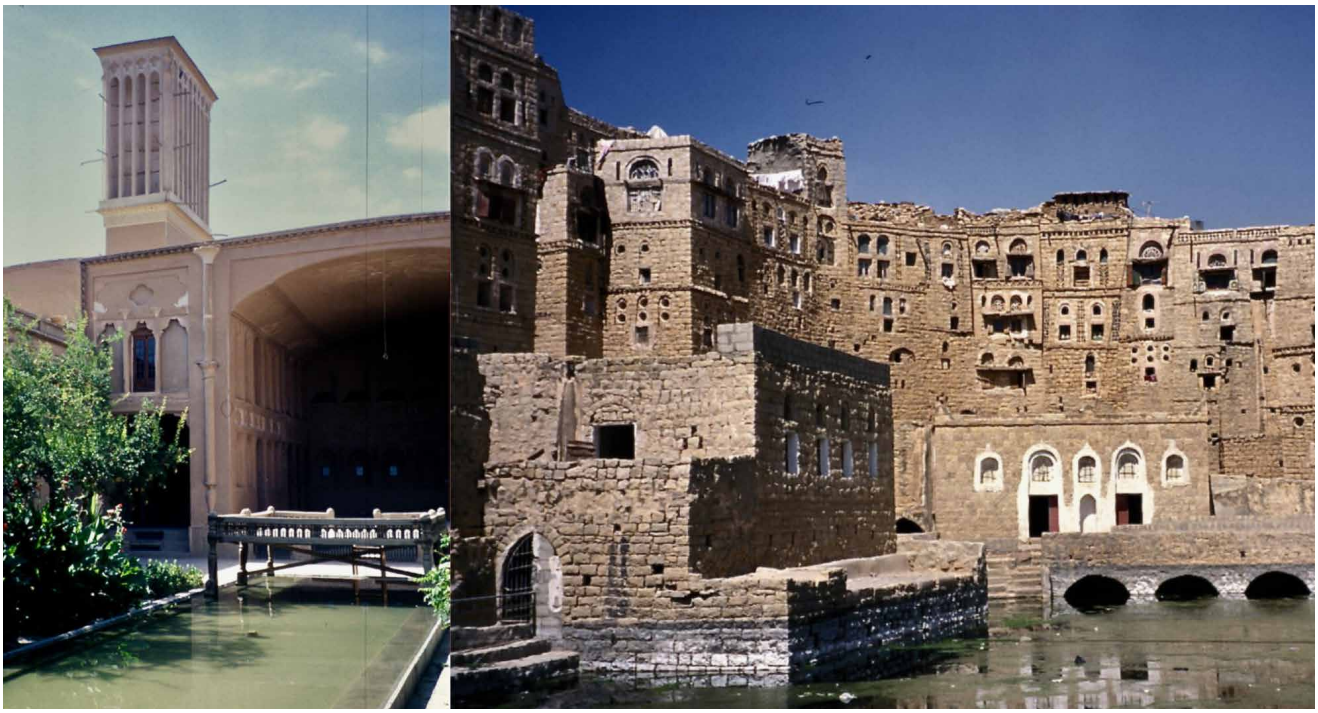


FIG. 6.4 Wind tower above a water management feature in Yazd, Iran (left), and centrally positioned reservoir with dense occupation around it in Hababa, Yemen (right). Images courtesy of J. Meunier.

The second is the design of both single- and multi-family dwellings with courtyards, a design choice that provides opportunities for creative management of air, light, heat, and water, while also providing both privacy and opportunities for social interaction.

In such cities, the central courtyard allows the building to be constructed out to the very edges of its site, gaining most of the necessary light and air from within, rather than depending on a wasteful buffer around it of often useless space. The courtyard becomes the focus of the building; the major rooms face it and can be open to it at cooler times of day or season.

This courtyard can be enhanced with amenities such as a fountain, a pool, and leafy plants that provide additional cooling. This pleasant area offers a social focus for the inhabitants of the building. In some courtyards in Iran, for example in the desert city of Yazd (Fig. 6.4), the pool in the courtyard has a wooden platform across it where dwellers gather in the evening to eat and converse. The courtyard has on its southern edge, facing north, an open porch for use in the summer, and on its northern edge, facing south, a winter space. Air movement through these courtyards is boosted by wind towers that climb above the rooftops and channel air from all directions down into, and out from, the buildings and courtyards.

The dense arrangement of the city also leads to an efficient management of flows. Management of water is, obviously, especially key in desert environments. *Water harvesting* is a term that needs to be understood and embraced; desert cities throughout history have practiced it. The modern desert city may harvest water at the scale of the watershed and the region, but local water cisterns, at the scale of the individual building and the small community, were widely used throughout history. At the center of the small town of Hababa, in Yemen, is the town cistern, surrounded by a wall of houses and a small mosque, into which the winter rains are drained and stored (Fig. 6.4). Other cities could benefit from such a fine-grained attitude towards water conservation. The continuing use of gray water is evident in Sana'a, Yemen, as it irrigates city gardens where fresh vegetables are grown.

In modern times pumps and pipes bring water from great distances, changing patterns of water use as well as cultural attitudes towards water. The sense of water as a scarce and precious resource, to be used sustainably, has been displaced by a purely utilitarian attitude that seems to encourage wastefulness, recalling the Jarvis Paradox (Tainter & Allen, 2019). In old cities such as Jaisalmer in India, drainage systems are not adequate for the excessive use of water, and the foundations of older buildings, not built to withstand moisture, are eroded. In other regions, such as the dry Andes, a neoliberal structural adjustment framework has commodified freshwater and demolished the water commons.

6.4 – **Contemporary Cities as Ancient Urban Laboratories**

The case for exploring archaeological examples as urban laboratories ultimately rests on the belief that the past contains examples of persistence and decline that we cannot see in modern, living cities. A second issue is whether the examples of the past apply to contemporary challenges. Our contention here is that these living examples, far from eliminating the need for archaeology, complement and underscore it. Together they form a dialog that is best understood when they are used in concert. The tools of archaeological interpretation, and the long lens it applies to the archaeological record, provide unique insight into these examples, and a new vocabulary with which to discuss them. Although our focus in this work remains cities of the past, we are excited to extend our interest to cities of today. In the sections that follow we will continue to examine contemporary cities that are moving ahead on the path to a durable future.

7 – Achieving Durability: Learning the Lessons from the Past

It seems like a truism to say that a city or an urban region becomes durable only by enduring over long periods. What we mean by "achieving durability" is something subtler: the form changes through time and is shaped in an organic process toward a solution that is durable to the challenges it will face. Sometimes this plays out by the repeated growth, collapse, and replacement of specific cities as a region moves forward. At a tighter chronological scale, we see individual cities shape, and shaped by, their specific niches. We see the long-term persistence of this adaptive substrate, often continuing on past the higher-level power structures resting atop—and, frequently, exploiting—it. We see these successes alongside false starts and failures, of which there are many; we see also that failures on one time-scale become resources for future strategies on longer scales. Achieving durability requires time because it is not easy to achieve.

The preceding chapters have provided a tour of cases where an archaeologically informed view over very long time scales reveals what we are terming durability. Here we pause to reflect on these examples and extract from them a guide for how durability was achieved in the past and can, we believe, be planned for in the future. Following other models (Nijhuis, 2013; Nijhuis et al., 2020; Sun et al., 2019), we proceed with the belief that by interpreting the accumulated knowledge hidden in durable ancient urbanism, principles can be derived for the development of supportive urban landscapes, adaptive design, and re-use at multiple scales.

7.1 – **Durability Requires Integration with the Natural Environment**

An obvious recurring thread in the examples we have examined is that understanding of environmental conditions is an important characteristic of a durable urban region. Knowledge of and respect for the biophysical environment and its climate and hydrological processes are the basis for durable urban systems.

This principle has shaped all of our preceding examples. In Aksum, the occupation of the narrow topographic band, the exploitation of the opportunities it afforded and the navigation of its constraints (including the active *creation* of new opportunities), guided the development of strategies that supported the burgeoning kingdom and the continued ways of life after its fall. The Maya extensively transformed their landscape, but also secured a distinctive urbanism that persisted for centuries. Atlantic Europe constructed a suite of ways of life built on systems of farming and land tenure that, while varying widely at the regional scale, was matched by a distinctive social system that buckled, but did not break, under a markedly different Roman form. The cities of Mesopotamia, typically built on the sides of shifting waterways, rose and fell with a changing natural rhythm that we see playing out across millennia in the archaeological record.

The need to integrate a city with its natural setting is widely known and accepted. But habit, based on the easy energy of fossil fuel, means that we currently do not practice this very well. We do not employ a system that could easily heat or cool a building passively; the habit and convenience of standard designs pulls us away and has led to the loss of considerable knowledge. How, when we have the knowledge, can we struggle to break from our habits? Designing and engineering with natural spaces and processes, and their respectful utilization (e.g., making use of natural resources, dynamics, cycles), is a key feature of a durable system.

7.2 – **Durability Avoids Waste through Re-Use and Circularity**

At the heart of durable ancient agriculture and the production of materials and structures were landscapes maintained, at different scales, through closed cycles of nutrients and materials.

This, too, was deeply interwoven into our archaeological examples. The Aksum farming cycle passed nutrients and material through the system multiple times before it would be lost. Agricultural and water management systems in Maya agro-urban landscapes were similar. In Mesopotamia, the reuse of water as it moved downslope from the levees was a key strategy.

Many cities have made progress in this regard—central composting is one example—and some designers have worked to have zero waste in the construction of their projects; however, this is still not the norm. More can be done: for example, making packaging compostable or growing food closer to our urban centers. Other "cradle to cradle" strategies can be envisioned, and there are archaeological examples that show how to this could be achieved.

7.3 – **Durability Leverages Multi-Functionality**

Another important characteristic lies in multi-functionality. Ancient urban landscape planning included multiple-use structures and infrastructure that integrates safety, defense, fresh water supply, agriculture, social interaction, and more. Combining activities—such as sociability, recreation, and other events of public life—with water drainage and storage made it part of people's daily life.

Multi-functionality is a salient component in several of our example cases. In Aksum the use of crops for their products but also as erosion management is one example; the use of animals to work, for food, and to provide additional nutrients on the field is another. In Maya cities, plazas and causeways served multiple functions: as water management features, transit routes, and stage settings for public display. Mesopotamian canals, themselves used for water delivery but also transport and travel, were lined with trees that provided stability, shade, and fruit.

This is increasingly becoming a more common practice in contemporary planning and design. Most parks have multi-functional benefits, as their design can prevent flooding, produce clean water, provide recreation, wildlife habitat, and even food. In current design circles, this multi-functionality is increasingly seen as advantageous and, in some circumstances, it is recognized as necessary; such cases are making multi-functional planning increasingly culturally acceptable among today's urban planners and designers.

7.4 – **Durability Operates at Multiple Scales**

Another characteristic is that the development of a durable urban system addresses multiple scales that, taken together, make for a complementary system. It implies a multi-scaled spatial approach where every urban landscape element plays an important role in safeguarding and employing natural resources in a regional context (e.g., drainage/irrigation, use of rainwater, etc.). Thus, urban functions can aggregate into single cities or can disaggregate across regions.

The multi-scale aspect of durability is visible in our example cases. As the epigraphic record documents, the Maya city reflects a polity that was often in flux, as allegiances shifted and fortunes rose and fell. The city itself distributed its functions at scales that reflected the spatial arrangements of different resources on the landscape. This was even more salient in the example of Atlantic Europe, where the urban functions were distributed across both time and space, at multiple scales. In Mesopotamia, the political situation was also one of shifting alliances; some aspects of durability could be found in individual cities while others—for example, the extensive canal system—extended across the landscape in a broader, linked system.

This hints at contemporary issues at even greater scales. While the scale of many of our examples may be more regional, we can see parallels when we look at climate change migrants moving from one country to another. We believe that practitioners can look at our archaeological case studies and see solutions or unseen problems for current organization and planning.

7.5 – **Durability Leverages Diversity**

Diversity is key to durability. Its centrality lies in the fact that what endures must be able to shift its footing among multiple opportunities. A portfolio of resources and a repertoire to exploit them are the key ingredients; reliance on only one source of support invites disaster. This diversity, however, manifests itself through the entire system: it is not enough to have a secondary option for a given resource, but there must be the right people to manage it and who know how to exploit it when a shift is needed. This means that diverse resources must be coupled with diverse institutions and diverse population. A single "way of life" is not enough; there must be multiple ways to live.

In Aksum, a set of strategies formed a repertoire that could be adjusted as needed in the face of different problems. In the Maya world, immense resource diversity with a disaggregated arrangement across the landscape was an enduring feature; this promoted an urban form that echoed and exploited it. In Atlantic Europe, diversity in space was accommodated by disaggregation of city functions in space and in time. Over the long record of occupation in Mesopotamia, the cities that flourished and endured the longest were positioned at the intersections of biomes; they provided food security and cities could flexibly move from exploiting one set to another as they faced various challenges over time.

In today's urban designs, increasing thought is being given to these challenges. In both the periodic assessment of historic resource portfolios and their maintenance for future use, cultural heritage can be an important motivation for public engagement. This is heartening, but we would add that if it is used primarily to withstand a shock without fundamental change, it is insufficient. Instead, public engagement with the idea that change itself can be managed, and that more than one path forward can be charted, selected, and enthusiastically—rather than reluctantly—pursued.

7.6 – **Durability Requires Coordination among Multiple Groups**

To become durable requires more than a building project; durability comes from physical infrastructure, but also from institutions, knowledge, and social relationships. A community of neighbors who know each other and each other's families, and who, through long experience, know how to respond in the face of tragedies—when the water rises, or the rains do not come, or the fires pass through—is far more effective and durable than any piece of infrastructure yet devised. Durable urban systems require a collaborative effort among people/social groups, authorities, and experts with different disciplinary backgrounds. Systems consist of natural and social processes that are often interdependent and therefore need common understanding, shared responsibility/trust and adaptation/transformative strategies (e.g., rice cultivating cultures, in which people are dependent on each other to make the system work, or the Dutch polder system).

We see this coordination in all of our examples. In Aksum, the land tenure system permitted the land to be worked according to the agile pattern of agriculture driven by the environment's constraints. Water linked people in dramatic ways in the Maya example, requiring the coordination of elite at the center of the water system and those at its periphery who were dependent on it but who in turn supported the elite. In the Mesopotamian example, the links extended across the landscape via the canals (as also seen in the case of Phoenix, both ancient and modern) which required coordination for their construction, maintenance, and operation. And in Atlantic Europe, we have seen that a distinctive set of social institutions arose that fostered the coordination among many disparate groups via primarily egalitarian and even democratic practices.

This principle extends beyond business-as-usual planning. To achieve durability, we must think critically about how we might respond to crisis and that we might, or might not, succeed. Can our organizations incorporate this ideal? When one leader can make complex plans and preparations and another remove them, or if bureaucracy is too complex or stagnant to take actions based on the knowledge available from different groups, are we trapping ourselves? Are our institutions built for durability?

7.7 – **New Lessons in Existing Theoretical Frameworks**

The above characteristics allow two threads of our findings to intersect. In the first, management of common-pool resources leads to arrangements among users such that the resource is not depleted, but instead is maintained and developed, and all those who have a stake in it also support its maintenance. This process, contra Hardin's (1968) view that it would necessarily lead to "tragedy" when selfish individuals overexploited the resource and exhausted or destroyed it for others, allows multiple users to gain the benefit of the resource while also maintaining it. The specifics of the community determine the best management structure. How is "cheating" achieved, detected, and rebuked or punished? What constitutes legitimate use and membership in the group permitted to use it? Ostrom's (1990) work on this shows that Hardin was too pessimistic, and that such resources can be maintained for long periods. Indeed, we believe this may have been much more common in the ancient world than our modern capitalist-trained selves might believe.

A second thread is the concept of *landesque capital* (Håkansson & Widgren, 2014); this is the idea that some mechanisms of transforming the means of production (such as improved technology) merely reduce labor but do not affect output, while others transform the landscape into something more productive than it once was. These physical improvements can build upon one another, such that the productive capacity of the landscape is greatly increased as the landscape itself becomes more anthropogenic. Our assessment of past urban regions bears these signatures writ large: cities are the ultimate transformation, and the regions they occupy can be exploited and destroyed, or they can be modified in a way that leads to a deeper and more lasting improvement.

Together, common pool resources and landesque capital comprise the social and physical conditions which permit durable management. One reason that the vast majority of modern cities do not support durable management is because they are constructed piecemeal as "properties" by workers who may never enter the buildings erected with their labor. As Jacobs (1992) noted long ago, communities are durable when residents, through social and political engagement, take interest in their physical maintenance. Today, we can see this assertion at work in the investment of time and effort in urban gardens (Keep Growing Detroit; http://detroitagriculture.net/) and the popular struggle to maintain parks and other open spaces (Reclaim Istanbul; https://reclaimistanbul.com/2014/01/27/occupygezi-the-park-revolution/). Although many city managers embrace such efforts, these initiatives need not include entire cities. For neighborhoods in cities and for villagers and townspeople in more rural settings, Jacobs' observations have been put to work. All sorts of common spaces (such as plazas and causeways for the Maya, fairgrounds and markets in many places, present-day community gardens and parks) could become a form of the commons, to be managed and developed by communities of use.

The characteristics we have discussed are based on our observations of durable urban regions in the past. We believe they can be the basis for durable future settlements and can serve as a guiding force for ecological development, circularity, transportation, agricultural production, settlement advancement, social connection, and governance.

8 – Deploying Durability: Applying the Lessons from the Past

Landscapes that are sharply divided between rural and urban are only one of the myriad forms that allow people to aggregate into groups; in novel future conditions, the analysis of other forms and their social and environmental contexts can inspire new possibilities, provide useful guiding principles, and suggest solutions to new challenges. In this section we turn to some recommendations that a review of these laboratories of the past offer for contemporary cities and urban regions as they face a panoply of challenges as we move further through the twenty-first century.

As a preamble, we must address a false—but useful—dichotomy. At a very high level, the options available to cities and urban regions can be interpreted as reflecting two opposing directions: a centripetal option that leads to cities that are more densely occupied, and a centrifugal option that leads to counter-urbanization, the dissolution of dense city centers, and an outward progression of population and city functions. This is an incomplete interpretation of our argument, but we can consider it for a moment as a useful framework within which to introduce our proposals.

We start by admitting that there is a bias in the selection of our examples and in our overall argument: we have favored in several of our examples urban regions and cities that have survived due to low-densities and distributed city functions. In these examples we have emphasized that low-density cities, especially when combined with urban agriculture, can be an effective and durable strategy. We are drawn to this because the prevailing examples in our contemporary world seem already to be centripetal: densification seems to be the default. Low density urban areas exist today, but in a form that may even be aberrant, an outcome of the explosion of the automobile and cheap transportation, such that cities sprawled widely without much concern for maximizing efficiency. Many such areas are now benefitting from belated reconfiguration to replace the car with better options—walkable cities, public transit, mixed use areas, etc. (see Box "Covid-19 and Cities").

COVID-19 AND CITIES

We are making this argument at a poignant time. Among the chief forces that act to repel people from cities' centers is disease (Cartwright & Biddiss, 2000); within the time that has passed since the last of our original workshops, time that we have spent preparing this MS, the coronavirus pandemic has struck almost every area in the world. City streets in many places have been periodically empty; densely populated areas are seeing this disease, with its insidious ability to be spread by asymptomatic individuals, pass from person to person with terrifying speed. There is evidence that a single football match in Milan—attended by more than 44,000 stadium fans and many more at gatherings in bars and homes and associated travel in vans, trains, and buses—lit the fuse on the catastrophic outbreak in Lombardy that followed (Hope, 2020). This supports an argument that urban density carries costs, and it is also in line with our larger argument that cities are ecological entities.

Discussions about the impact of the disease on urban forms in the short- and long-terms are beginning to take place (Williams, 2020) but are still largely speculative and dependent on many unknowns, including the effectiveness of testing, tracing, treatments, and vaccines for this disease as well as others that may follow. We look forward to this discussion as it takes shape, and we hope that our contribution draws attention to the archaeological record as a source of inspiration when considering possible courses of action.

However, we wish to elevate the examples that oppose this trend to densification, in order to ensure that this is recognized as a valid (and often preferable) option. Archaeology can inform how densification might be done, but it is already a direction in which cities are moving. This opposite direction reveals the construction of an equally effective urban structure that is disaggregated. Such a setting distributes resources, functions, and power more widely across the landscape and the population; this is a perspective seemingly lacking in easy contemporary examples, even though such examples can be drawn from archaeological and historical records and a few contemporary regions.

We consider this is only a partial interpretation of what we are presenting. The apparent polar strategies of densification and disaggregation are, in fact, only the superficial aspects of what are richly nuanced combinations, innumerable variations of structure and strategy that can deal with the challenges that are specific to each city's situation. This will apply in all urban responses to the coronavirus and to all other challenges they may face. Cities can disaggregate or densify in many ways. True durability means refining, building, exploring, and developing new approaches that are in line with the challenges the region will face. Whether this means embracing density or planning for disaggregation depends on numerous factors, and how each of these would be achieved will vary; there is no one-size-fits all.

We can return to our central question: How can we transform the existing built environment to encourage durability and mediate the social context of risk and vulnerability? Based on the broad look just presented of cities through time and space, we group possible responses into three categories:

- Make changes to existing cities to reduce the threats to their durability.
- Re-envision and reinvigorate adjacent regions.
- Construct new cities in more supportive settings.

MIAMI: LUXURY RESILIENCE IN A COASTAL CITY?

The city of Miami has long had its feet in the ocean, but now the ocean wants more. The forecast is not simply for sea-level rise, as there will also be more powerful storm surges and hurricanes, low-lying neighborhoods will become uninhabitable, and salt-water will infiltrate Miami's aquifer. Not only will dwellings flood, but also "roads, bridges, power plants, airports, ports, public buildings, military bases, and other critical infrastructure along the coast" (Cleetus, 2018). The state of Florida, with the second longest coastline in the US, has five of the country's top twenty urban areas that will suffer most from rising seas (St Petersburg, Tampa, Miami, Miami Beach, and Panama City).

A venerable tourist destination and a magnet for investors, Florida's coastal real estate market remains, for the time being, robust. It is this tax base that can still pay for necessary changes in infrastructure to combat the effects of rising seas, and there are recent examples of "luxury resilience" (e.g., Monad Terrace, a proposed hi-rise condominium being built on piers, several meters above the anticipated flood levels; http://monadterrace.miami; Shaw, 2020; Fig. 8.1).

However, this source of financialization is amplifying the vulnerability of less affluent groups in society. Miami's managers must now work quickly to mitigate, because if investors are scared away by a waterlogged future, it will dry up future revenue to make necessary changes. It is these kinds of difficult decisions, and the sense of urgency, that characterize many of the world's cities.

FIG. 8.1 Monad Terrace is an example of a new style of building that purports to combine luxury living with sustainable principles. The two images are from the developers' website, https://monadterrace.miami, accessed 30 May 2022.

8.1 – **Changes to Existing Cities**

Cities have always faced challenges, and today is no different. Each unhappy city is unhappy in its own way and will need to find its own solutions and its own path to them. For example, we can consider two broad categories that are representative of many cities and the challenges they can expect to face in the near future: coastal cities and desert cities. A changing climate will inundate the former (see Box "Miami: Luxury Resilience in a Coastal City?") and desiccate the latter (see Box "Phoenix: A Durable Modern Desert City?"), and these two kinds of problems will likely characterize the situations in which many city managers find themselves.

But each city will also be different. Changes to be made in a city's form must be done within a social context, and then, once changed, will reshape that context. If Phoenix transitions from car-based sprawl (Fig. 8.2) to a "dense network of intimate shady streets" (Meunier, 2015, p. 10) seen in other desert cities, it will mean the creation of new neighborhoods, new social relationships, new administrative functions, and a new sense of place and identity for its residents. If it is accompanied by a new emphasis on the value of water, and new modes of interacting around courtyards, it may be a new incarnation of an older form of city life. If Miami transitions to a mode of "luxury resilience" that reinforces an inequitable distribution of the risks and damages of climate change, it may reflect and exacerbate tensions that already threaten modern world in which inequality is rapidly increasing, and further ensconce these into the urban infrastructure itself.

Within the archaeological view of this study, we can respond in two apparently contradictory ways. First, we can point to the principles of durability that would be reflected in the new arrangements, and critique them on the principles we have outlined above: do they incorporate reuse and recyclability? Do they exploit multi-functionality, and do they allow multiple interests to share in their designs and benefits? The second is that we can ask whether over the very long term these strategies are likely to be successful. Would a denser modern Phoenix last as long as the ancient one did? Or would Phoenix be like Nippur, taking its place in a long line of regional experiments that rise and fall on some future archaeologist's graph? Succinctly, we can ask if these changes are durable: do they solve only short-term problems with static solutions, or do they build in components that allow flexibility and change through time, and will they become the pieces out of which the next durable strategy is to be remade?

PHOENIX: A DURABLE MODERN DESERT CITY?

Desert cities will face different challenges than will coastal cities, but these are no less urgent. For example, the population of the Phoenix metropolitan area now exceeds 4 million (Fig. 8.2). Many of these homes are in areas where green lawns and golf courses spread out under the clear skies that are sunny nearly 300 days per year. The water that supports this comes from the Salt River to the east, from Phoenix's own aquifers underground, and, more recently, from the Colorado River, brought via pumps and canals more than 100 miles to consumers in the Phoenix and Tucson areas. Together these sources adequately support the population's water supplies, and even allow Phoenix's original focus—irrigated agriculture—to continue. The outlook for Phoenix's water supply in the near-term is not immediately dire.

But the managers of Phoenix, and the residents and consumers as well, understand that "not immediately dire" is not the same as "permanently secure". Rainfall and snowpack supplying the Colorado are far less than in previous years and are decreasing. The Phoenix metropolitan area is a sprawling expanse of highways and parking lots that have created an urban heat island that drives up the temperature beyond what warming climate would achieve on its own. Higher temperatures (in 2019 the temperature exceeded 40 degrees C (104 degrees F) on almost every day in June, July, and August) amplify consumption of energy and water.

Responses to this are already underway. Phoenix has always been a city in a desert, and its architecture reflects this in some places (see, for example, Meunier, 2015). More is being done. The recent construction of light rail connecting Phoenix to Tempe with an associated pedestrian corridor promises to implement some of the principles from other desert cities, including (quoting our text above) "small precincts for residential neighborhoods without through traffic forming a compact urban development pattern with no waste space".

But as in Miami, solutions to the physical problem must take place within a social context. The Phoenix metro area is a collection of previously independent towns; few open spaces exist between these, but each remains independent. This legacy administrative structure of multiple competing municipalities may work against the design of equitable and sensible allocation of resources (specifically the apportionment of water from the Central Arizona Project Canal) (Murphy et al., 2019).

FIG. 8.2 A section of the Phoenix Metropolitan Area from the air, with modern canal at right. Image courtesy of J.T. Murphy.

8.2 – **Reinvigorating Regions**

In many areas of the world, the adoption of agro-business and the lure of cities have reduced rural population, leading to the widespread economic and social collapse of rural communities. New approaches to durable cities and food systems must include the regeneration of the countryside and the return of services to the non-urban population. This is especially important in resource-abundant regions, which are home to a significant percentage of Earth's population and where much of the world's food, fiber, fuel, and fodder is grown. Future changes in the climate of such regions are likely to reduce their size and fertility. Future food security depends on restoring the services that make it possible to live in rural areas.

How could this be achieved? The pattern we have seen in Atlantic Europe (Chapter 4) offers an example of one way forward. There, rural networks fostered values we today appreciate as democratic, and after major upheavals the re-population of the countryside stabilized society. Urban functions were distributed in space (via, for example, specialized markets, manufacturing, and educational towns) and time (seasonal fairs, and social, political, and religious events), but in a less-dense pattern of settlement that could accommodate more participatory forms of governance.

What could this pattern look like in the future? Under what environmental conditions could this work? Mobility in less densely populated areas can be restored with transit powered by sun and wind, and some future version of the internet can provide global connectivity. Jobs in sustainable agriculture, forestry, and other professions can make rural economies magnets for innovators and young families, while retirees can find a supportive community in a green countryside. This vision is not simply pleasant to contemplate; it is also practical insurance against urban decline, drawn upon time and again by our forebears.

8.3 – **Construct New Cities in More Supportive Settings**

The relocation of entire cities seems dramatic from the time frame of any single individual, but the long-term record shows that cities have been relocated frequently throughout prehistory and history. The challenges being pressed upon contemporary cities may lead some—such as coastal cities facing rising seas—to pursue this option. That many of these cities are of recent origin gives rise to special concerns. Central to this is the vulnerability of many of today's newly built cities and of established cities that are in precarious locations. Cities that endure must be set in regions that will be able to support them in times to come, that is, to be enmeshed in support systems that focus on the region and integrate at different administrative scales. This issue requires an approach that takes environmental/ecological and social systems as a tightly coupled entity; humans and their environments must be addressed together. Furthermore, every place in the world has unique opportunities and constraints that must be evaluated. The question then becomes what are the available resources (e.g., environmental, human) in the surrounding region? What is likely to happen to these resources in changing social, political, and environmental circumstances? What can be done, now, to boost the durability of regions and diminish reliance on distant sources that are likely to be equally vulnerable to systemic change?

Cities that were established, or gained importance and population, in periods when colonial powers suited themselves, became convenient to shipping and other practical needs of the new order. A contemporary example is Indonesia's capital of Jakarta, among the fastest-sinking capitals in the world. Catastrophic flooding, due to rising sea levels and subsidence caused by water extraction from shallow aquifers beneath the city, is only one of Jakarta's challenges; other problems are rapid urban growth (the city is home to 10 million people), air pollution, and congestion. The new capital, scheduled to be completed in the next decade, will be moved to a site more central to the nation and more environmentally stable (LeVine, 2020; Rustiadi et al., 2021).

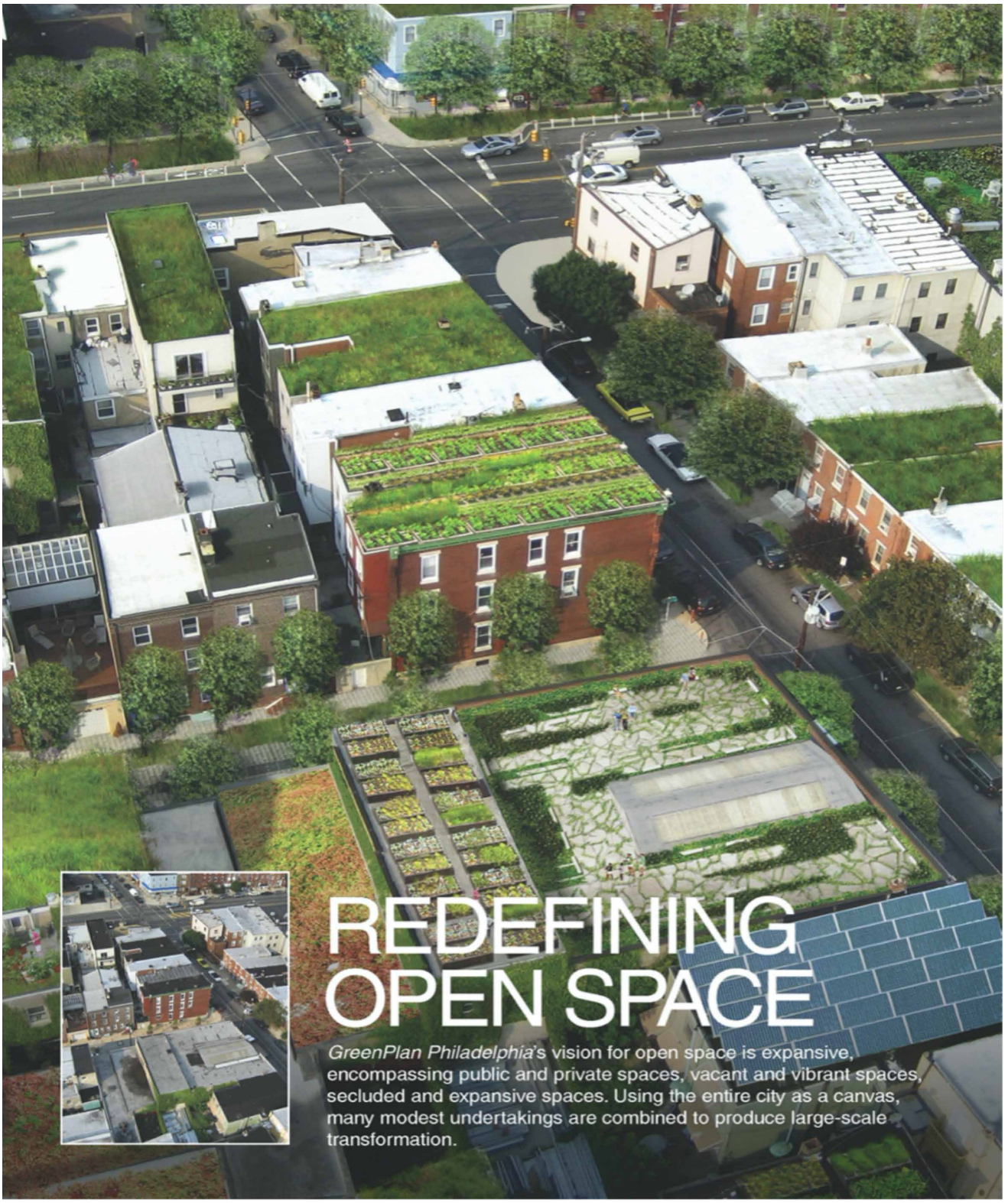


FIG. 8.3 Green Plan Philadelphia. Image courtesy of WRT Design

8.4 – **Now and Future Cities**

Around the world, cities like Miami and Phoenix will all struggle to find their solutions. However, we can provide some examples of cities that are, today, undergoing changes that incorporate some of the lessons we have examined here. Whether garnered from the archaeological record or not, many of the principles are increasingly understood by the landscape architects and urban planners whose job it is to design for a city's future.

8.4.1 – **GreenPlan Philadelphia, USA**

The city of Philadelphia, Pennsylvania boasts one of the most progressive plans in the US. GreenPlan Philadelphia (Wallace Roberts & Todd, 2010) takes an innovative approach to comprehensive open space planning and the development of a socially and ecologically inclusive and water-sensitive green infrastructure (Fig. 8.3). An inter-agency management team has working groups on broad interrelated issues: stormwater, economic development, data and measurement, health, quality-of-life, and the environment. A civic engagement process, coordinated by the state's Horticultural Society, canvassed every neighborhood in the city. Eight green elements and projects are measured against how they benefit sustainability for the city over the long term. The eight elements include: trees, trails, renewable energy, external building elements, wetlands, meadows, pervious and cool surfaces, and urban agriculture (WRT | Planning + Design | GreenPlan Philadelphia, n.d.).

8.4.2 – **Adaptive Urban Transformation in the Pearl River Delta, China**

This project concerns sustainable, multi-scale planning and management for more resilient urban deltas and, in particular, the adaptation of the dynamics to address increasing flood risk by integrating urban planning and water management—and engaging with stakeholders. The Pearl River Delta is a heavily urbanized region, home to several cities including Hong Kong, Guangzhou, and Macao (Fig. 8.4). Its strategic location and superior soil quality support development as a global economic hub. At the same time, however, deltas face extreme vulnerability due to multiple threats related to both climate change and urbanization. Urbanized deltas can be understood as a set of complex socio-ecological systems, each with its own dynamics and speed of change. To ensure a more sustainable future for these areas, spatial strategies must strengthen their capacity to face natural and artificial threats. Based on an assessment of the dynamics of change regarding the transformational cycles of natural and urban landscape elements, eco-dynamic regional design strategies are explored to provide more opportunities for natural and socio-cultural aspects within the processes of urban development. Furthermore, adaptive transformational perspectives are identified to ensure water safety and inclusive socio-ecological design (Adaptive Urban Transformation, n.d.).

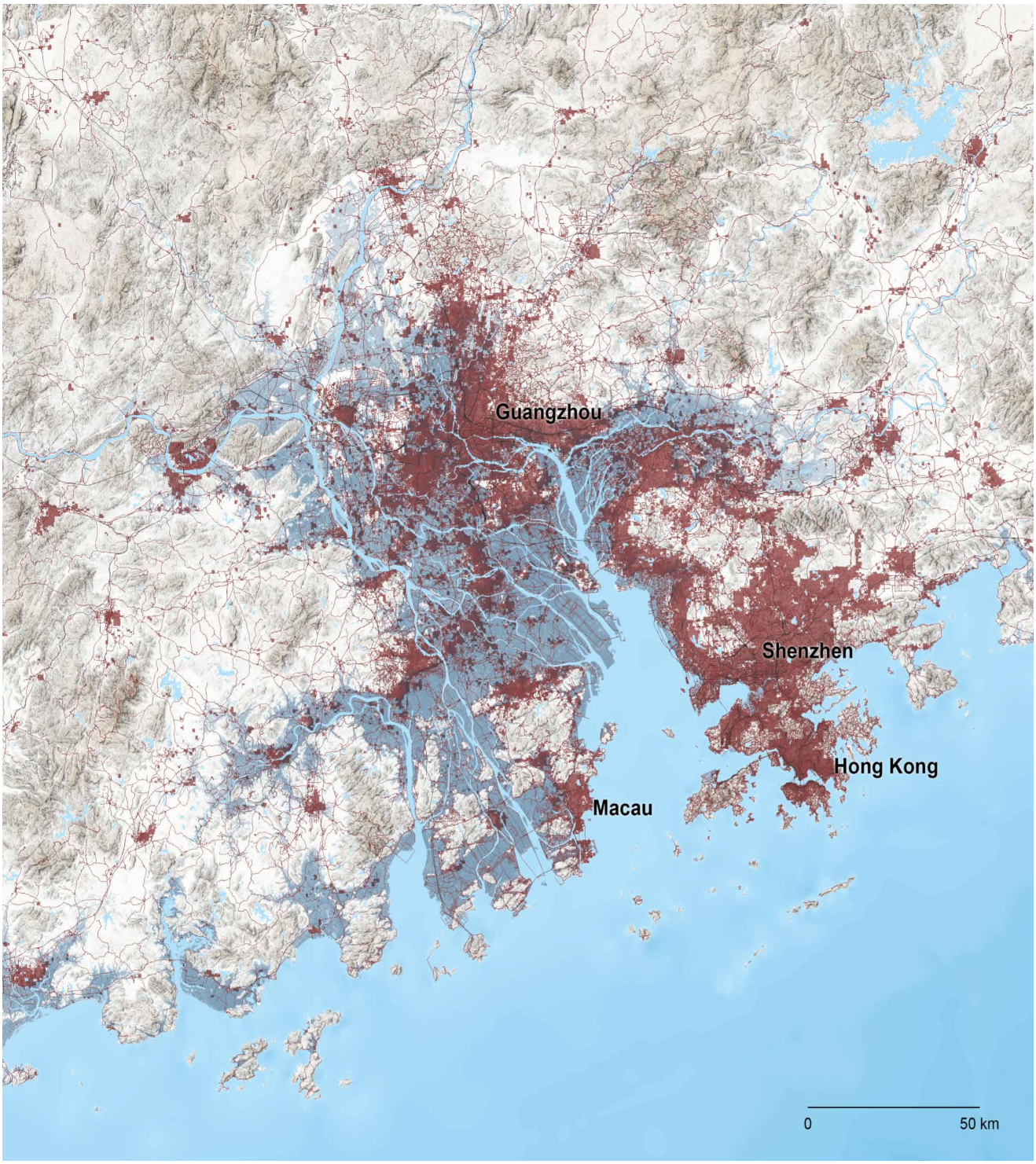


FIG. 8.4 The Pearl River Delta. Image courtesy of S. Nijhuis.

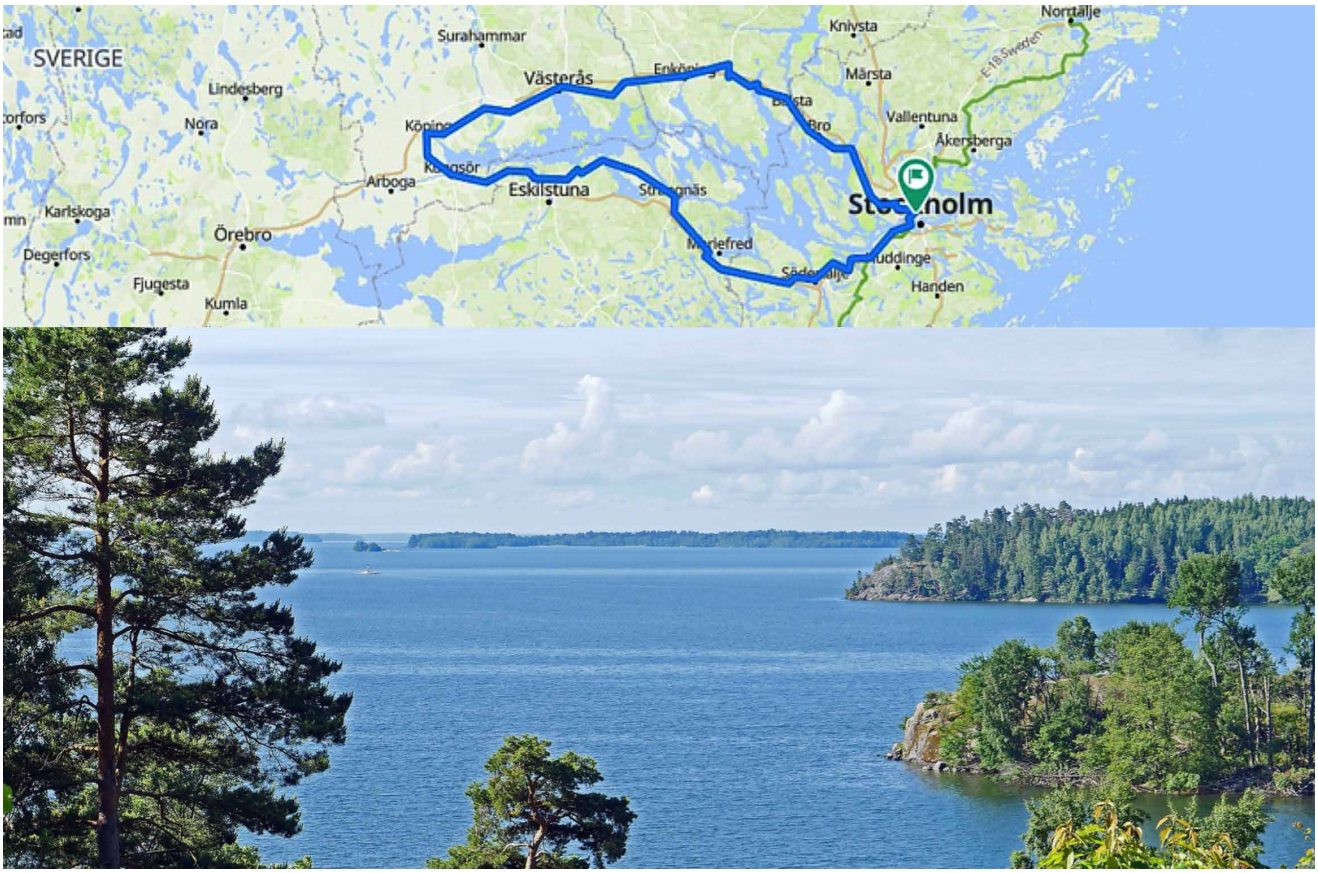


FIG. 8.5 Lake Mälaren is 120 kms (75 miles) long with an area of 1140 km2 (440 mi2). Globally rated 5th in urban water quality, it drains a region of 21,130 km2 (8160 mi2) and serves 3.6 million people in both rural areas and cities, including Stockholm. Regional map courtesy of BikeMap. Photo by Erik Westendarp via Pixabay.

8.4.3 – **Lake Mälaren, Sweden**

Some studies are already underway that use the principles of urban/rural integration that we recommend here. One such study is a recent, ambitious examination of the future of the Lake Mälaren region in central Sweden, which includes the capital city of Stockholm (Svedin & Liljenström, 2018) and drains into the Baltic Sea (Fig. 8.5). The project lays out the transition of this large region (3.6 million inhabitants) to a low-carbon economy by 2050. Characterized by considerable heterogeneity in land use, urban size, urban and rural economic prosperity, and environmental performance, the project integrates social and environmental data and technology to test the efficacy of different forms of government support (at multiple scales from national-to-local) under varying climate scenarios and world situations. It is such visions that can repair the rupture between cities and the regions that maintain them.

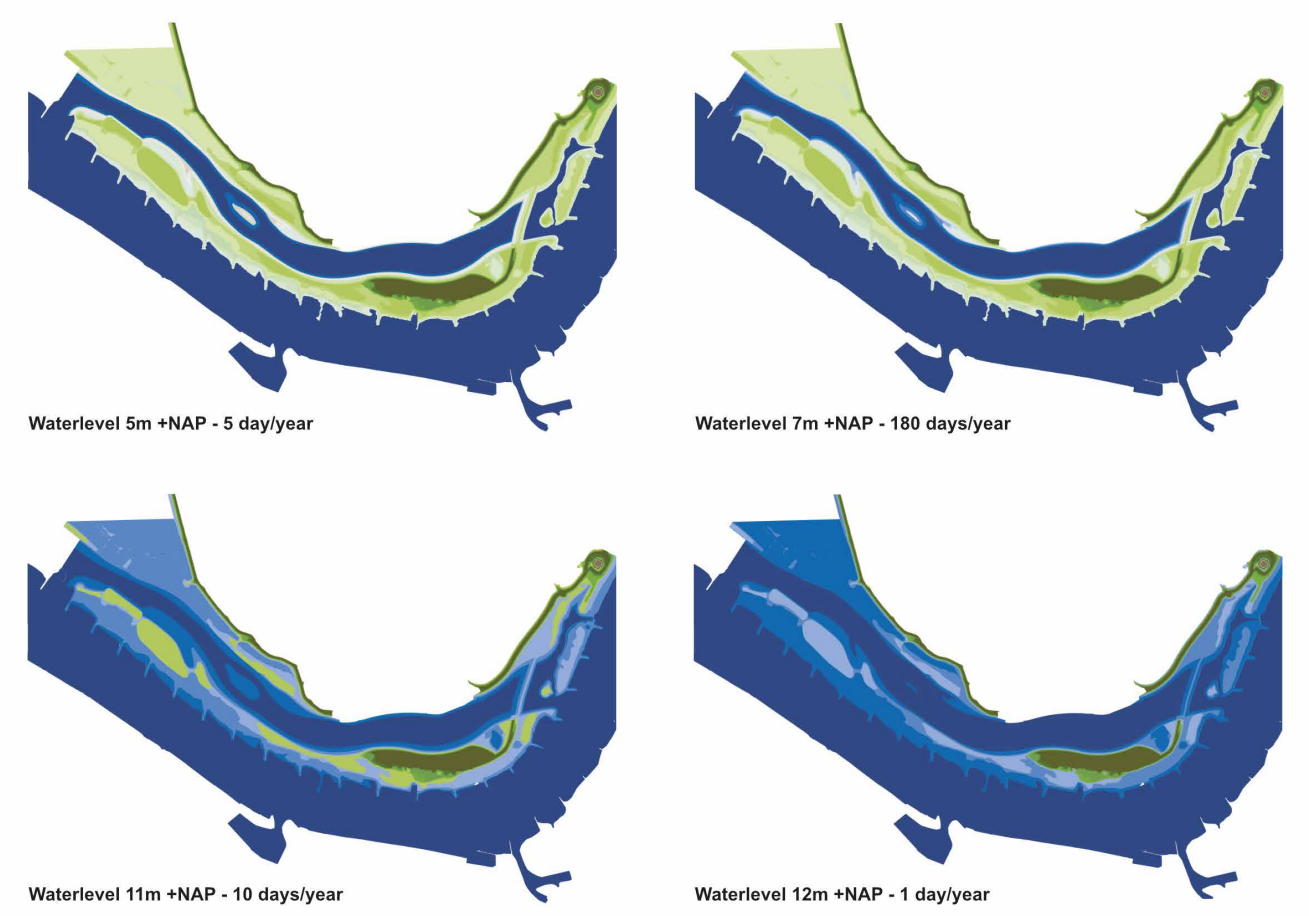


FIG. 8.6 Room for the River. Image courtesy of H+N+S Landscape Architects.

8.4.4 – **Room for the River, The Netherlands**

The Room for the River (2006–2015) project site encompasses four rivers: the Rhine, the Meuse, the Waal, and the Ijssel. The project area is in the Netherlands, but morphological impacts extend upstream into Germany, portions of France and Belgium and, over time, into the Rhine headwaters in Switzerland. For the Netherlands, the goal is to develop a resilient river landscape and to reduce flood risk (Fig. 8.6). At 39 locations, measures give the river space to flood and develop ecology, heritage, recreation and urban development. The design presents an integrated spatial plan with the main objectives of flood protection, master landscaping and the improvement of overall environmental conditions. Measures in the plan include: placing and moving dykes, removing polders, creating and increasing the depth of flood channels, reducing the height of groynes, removing obstacles, and the construction of a "Green River" which serve as a flood bypass (Sijmons et al., 2017).

FIG. 8.7 German Landscape Park. Image courtesy of German Landscape Park, https://www.urbangreenbluegrids.com/projects/landscape-park-duisburg-nord/.

8.4.5 – **Emscher Landscape Park, Germany**

Renewal of the heavily industrialized Ruhr region, the historic motor of the German economy, required development of connective green spaces through transformation of brownfields and open space as the backbone for urban development, industrial heritage, recreation, ecological development and natural regeneration of the canalized Emscher River. Factories and other buildings were remodeled to host corporate and cultural events, and Europe's largest artificial diving center was created in an old gasometer. Former ore storage bunkers were transformed into a climbing garden and a high ropes course in a casthouse; a disused blast furnace is equipped with a viewing tower. Visitors can walk or bike through the Landscape Park (Fig. 8.7). The highlight of the park is a light installation by the British artist Jonathan Park.

8.5 – **What All Our Yesterdays Have Lighted**

Shakespeare's Macbeth lamented that history "creeps in this petty pace from day to day, to the last syllable of recorded time". From the perspective of the modern archaeologist looking back at a record of millennia of human history and prehistory, the past can seem compact: dig a few feet down and you have moved a few hundred years. There is a danger that our presentation reifies this. We can gloss over transitions that took decades or centuries, and step over the years (or days, or hours) that were lived by the people at the time. This is dangerous because it oversimplifies: an urban area that we see at one time is followed by a revision at another, and this we have treated with an almost clinical dispassion. The archaeological record offers some shorter snapshots—the bakers' house in Nippur is one—but too often our view is overly long-term.

Similarly, we gain the broad view of these urban areas at the scale of the city or the region, but at the expense of the micro-view of the daily lives of the residents. We have discussed a bit about what life was like in these cities in terms of existing there—of farming, or of events or processions—but in this presentation we give comparatively little attention to what life was like in these cities in terms of social roles and the opportunities available. Choose a random child from these places and ask what they might become. It is likely that some became soldiers; it is likely that some became slaves.

Some of this is a limitation of the archaeological record, and some is more a limitation of our space to discuss it. However, for our larger purpose, it is important to remember that these limitations exist, and that they carry implications for our project. The most important implications are that we cannot assume that life in these places was what we would call good; nor can we assume that the changes we see were painless. We are not advocating that any of these places offer a life to which a person from today would like to return. Instead, we simply mean that there are aspects of the places that we might look to for inspiration as we build a new and better city going forward. We can use these lessons as reminders of how to design at the scale of the human body but also how to imagine or reimagine regional relationships or how to make them more durable and responsive to the increased threat of social and climatological stressors. These new cities should permit the roles and opportunities we see for our citizens of today and tomorrow: for education, entrepreneurialism, creativity, innovation, art, commerce, health, and free speech and thought.

The danger in eliding over long transitions in the archaeological record is that we forget that they often not only took a long time, but that they were achieved only at a high cost. Rarely was change ever gradual and smooth; more often it came with conflict, including violence and war, as well as environmental destruction and pollution. This is not universal, and this gives us hope that it is not integral. We hope that our explorations here help avoid these problems. The past offers us a guide to which way the currents of history flow and shows us patterns and principles to anticipate where they lead. If we see in a contemporary example a pattern we have seen before, we can choose whether to struggle against it. This choice is always appealing; it usually means maintaining the status quo, and often means that those who are at the top now will stay there, at least for a while. But this struggle has

losers, lives that are uprooted when things begin to fail. Our overall message is that we can choose to skip some of the worst outcomes and avoid the pain and damage that comes from fighting a losing battle.

Instead, we can create a set of visions for the future and choose from among them. We do not need to be Macbeth's fools, for whom "all our yesterdays have lighted… the path to dusty death". We believe that all our yesterdays have transmitted to us via the archaeological record a rich collection of case studies, and that we can extract broad principles from these and use it to illuminate a brighter path ahead. We hope to engage with city and regional planners who are charged with making decisions about what their cities will look like, how they will interact with their larger regions, and how they, and their citizens, will work together to avoid missteps and make better choices. They do not need to do this blindly: we believe that if we apply the lessons of the past, we can make the vulnerable urban regions of today into durable cities for the long-term.

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