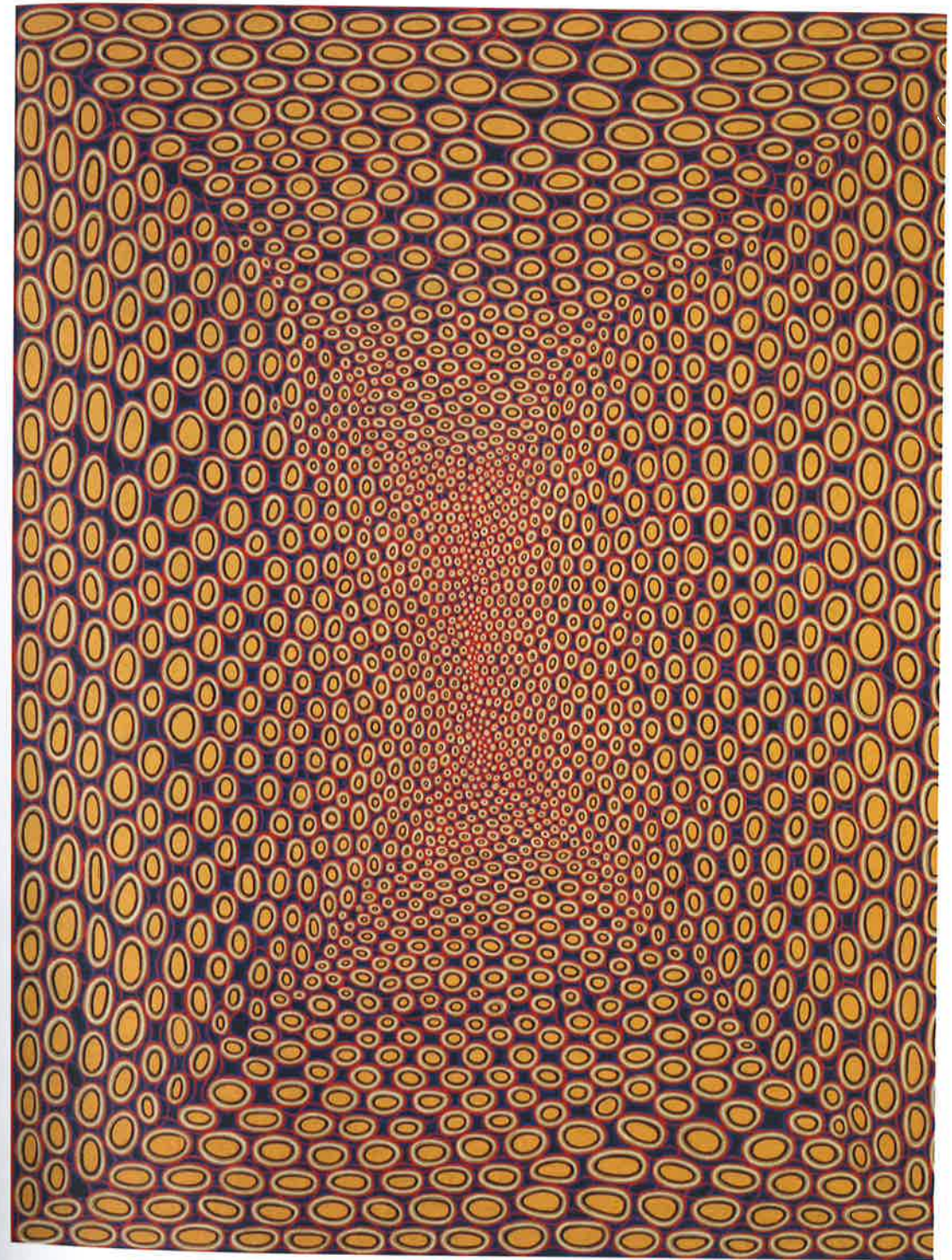
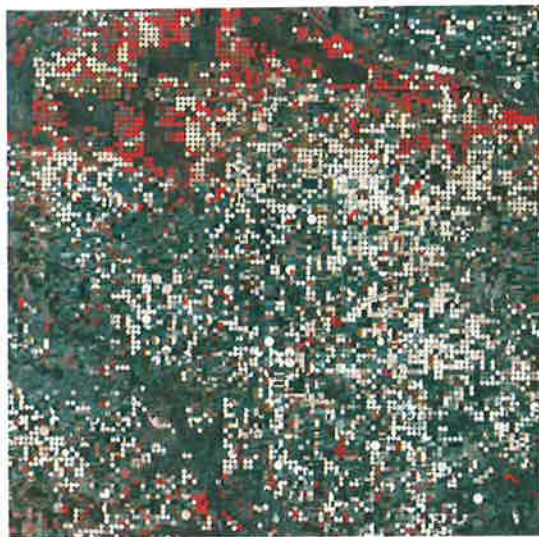


## Introduction



1. James Siena, *Battery*, 1997, enamel on aluminum, 74cm x 57.8cm.





2. Satellite image, Garden City, Kansas.

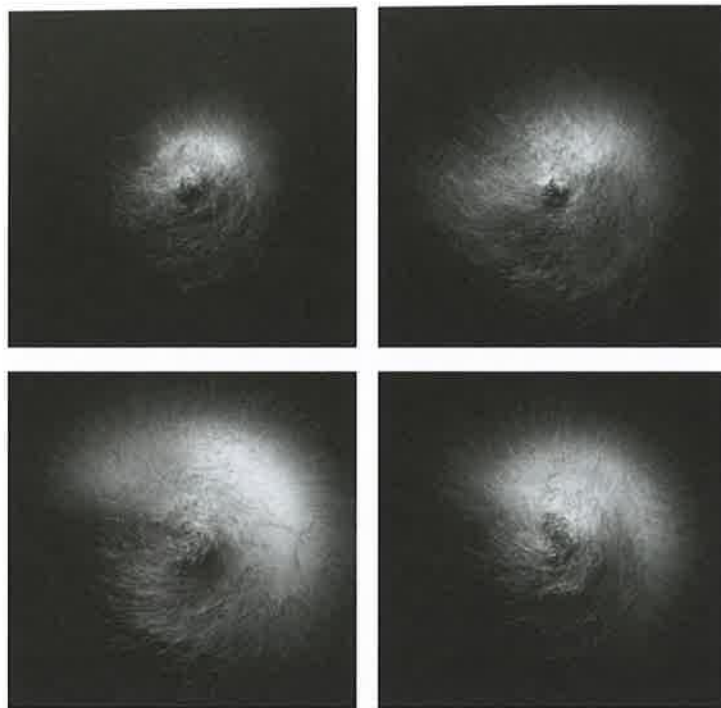
3. Satellite image, agriculture within an alluvial fan, Zagros Mountains, Iran.

4. Hubble Space Telescope image of the M101 galaxy. Highly complex and repetitive structures are found across scales, from the macroscopic spirals of galaxies to the microscopic helixes of DNA.

Patterns in designed landscapes are often understood as implying the imposition of order, reflecting human dominance over the complexities and flux of nature. At times they are equated with static surfaces, such as parterres and paving patterns; in other instances they are associated with the repetitive configurations of urban or agricultural land use. Yet the importance of patterns goes well beyond such readily recognizable formal attributes as simple surfaces or uniform geometries. Patterns—formal, material, or temporal recurrences—are essential for perception. Humans have an innate ability to recognize patterns; our brains are wired to perceive them and to seek them if they are not immediately visible. We look for patterns in nature in order to understand relationships between function and form, as in morphology, and between information and communication, as in genetics. Patterns are synonymous with processes; they are indications of the forces and interactions that created them. Since many designed landscapes are constructed interpretations of nature that are physically embedded in living processes, patterns have enduring relevance for landscape architecture both representationally and materially. As our knowledge of nature changes, our depictions of nature change correspondingly. The inverse is also true; that is, the tools and techniques used to measure and represent natural processes lead to changes in how knowledge is produced. Visualizations made possible through computation and digital imaging have provided new tools for understanding and depicting these processes. This being the case, a primary aim of *Dynamic Patterns* is to elaborate upon how various design techniques, especially those enabled by digital media, have facilitated different ways of seeing and making patterns and thus new ways of understanding landscapes and designing our place within them.

In our positioning of patterns, we seek to provide a framework for interpreting various projects that are emblematic of a broad shift in sensibility over the last few decades. This shift involves a diverse constellation of influences and ideas that derive from wide-ranging and differing interpretations of ecology. This gathering of ideas has led to an increase in

5. Mark Nystrom, *Wind Process 2015.01*. The wind series uses custom algorithms to plot collected wind data. In this instance, the plots start from a center point and then are "pushed" away from the center based on wind conditions at the time of data collection; for example, faster winds move the point a greater distance from the center while winds from the west push the point to the right. A location for the next second of the day is determined and a series of lines are drawn between the two points. This process continues until twenty-four hours of data have been interpreted.

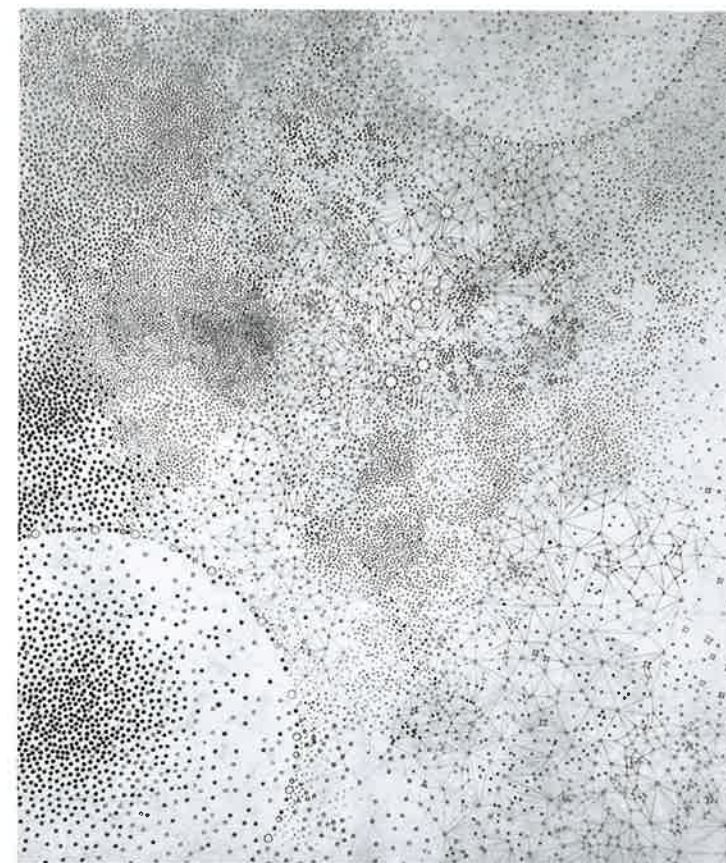
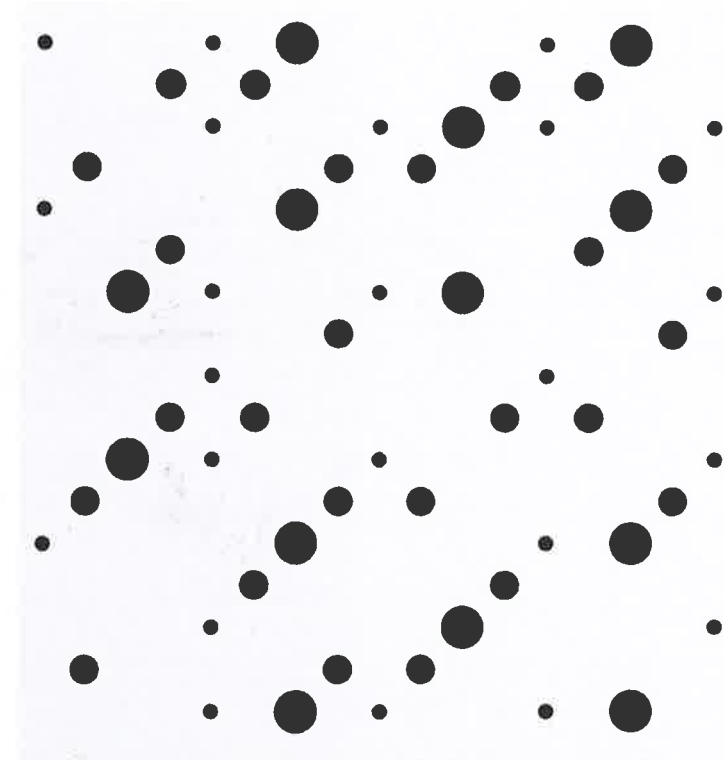


what might be called an "ecological consciousness."<sup>1</sup> Thus another fundamental aim of this book is to focus on patterns as a primary means by which the rise in ecological consciousness has been expressed in thinking and methods associated with design.

Although ecology as a science originated in the late nineteenth century, it did not become broadly popular as a conceptual framework until the 1960s and 1970s, when it began to be used to denote holistic thinking. This expansive understanding of ecology has further increased in recent years to encompass ongoing efforts to engage with larger environmental concerns. There are many ways to think ecologically, including by considering natural systems in land use planning; by developing "green" technologies; by paying attention to social-environmental interrelations across scales ("think globally, act locally"); or by adopting an all-encompassing "ecology of mind."<sup>2</sup> These expanded interpretations of ecology beyond science *per se* are prevalent in the humanities and philosophy, leading some to argue that ecology is the most significant epistemological framework of our time.<sup>3</sup> Not surprisingly, the effects of ecological thinking on landscape architecture have been profound.<sup>4</sup> To be clear, this book is not about the science of ecology, the application of ecological principles to the management of large-scale landscapes, as in landscape ecology, or the quantifiable functions of landscapes, such as ecosystem services. That ground has been well traversed by others. Nevertheless, the various approaches to pattern-finding and pattern-forming that we see in design today cannot be understood apart from

6. Bridget Riley, *White Disks 1*, 1964, emulsion on board, 132cm x 132cm. The abstract patterns of Op Art produce perceptual effects whereby the surface of the canvas appears to flicker, pulsate, and move.

7. Emma McNally, *S24 (detail)*, 2009, hand-drawn graphite on paper, 100cm x 140cm.

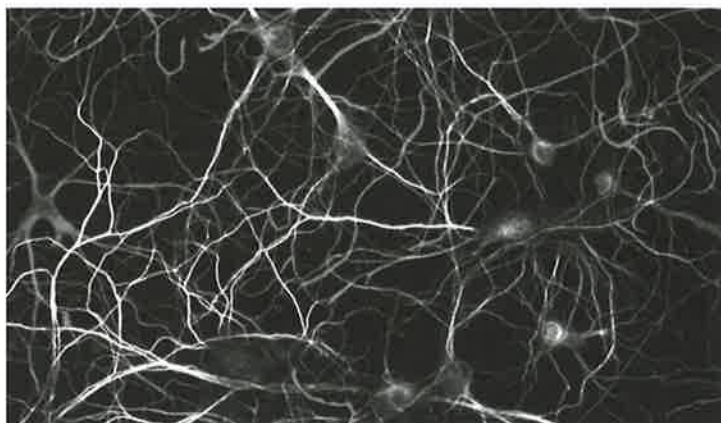




8. Jackson Pollock, *Number 32*, 1950, enamel on canvas, 269cm x 457.5cm, Museum of Modern Art, New York.



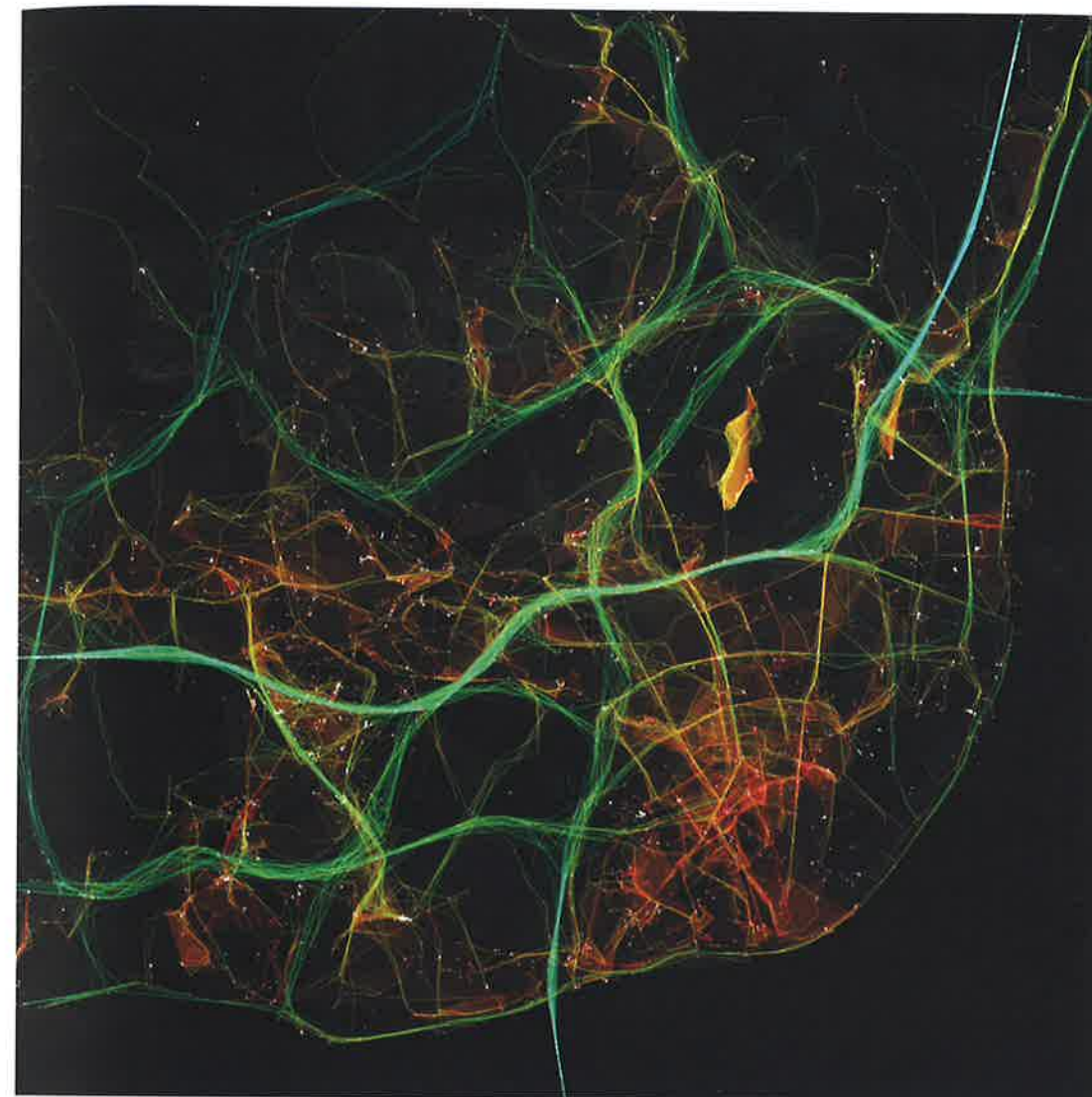
9. Image of cultured astrocytes, a type of brain neuron.



the influence of systems thinking, which entered into the discipline of landscape architecture largely through the field of ecology. For that reason, any discussion of patterns today must be rooted in a discussion of systems and ecology. The number of publications and diversity of scholars dedicated to examining systems thinking is profuse; here we will only briefly touch on the history and development of systems thinking in order to lay a foundation for explaining why this way of thinking has been important to landscape architecture and how patterns have been one of its primary manifestations.

If ecology and systems are common frameworks used to describe the constellations of relationships that we see in the world—the “what” of the world—then patterns are the “how,” or the means by which we come to know, understand, or express these relationships. That is the focus of this book. As the title suggests, new forms of digital media are central to these explorations. Our focus, however, goes beyond any particular software, design technique, or drawing type; rather, we emphasize the ways in which patterns are used as vehicles to understand, describe, and convey environmental processes.

We chose patterns as our organizing principle for two additional reasons. First, patterns exist outside such categorical distinctions as nature versus culture, which most people agree are no longer tenable in our hybrid world. Like hybrids,



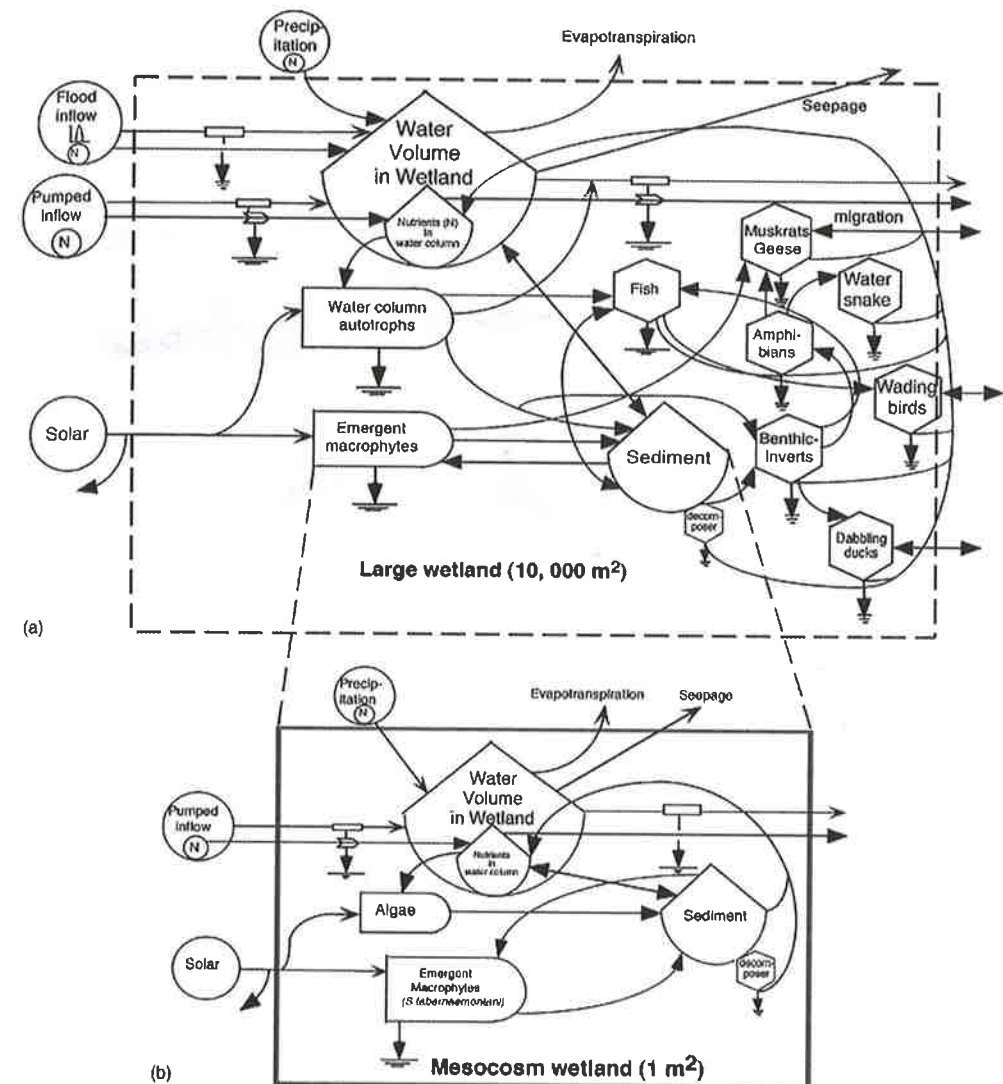
10. Pedro Miguel Cruz, Penousal Machado, and João Bicker, 2010. Visualization of traffic flow in Lisbon over a twenty-four-hour period through the GPS trails of circulating taxicabs. Line thickness and color represent traffic density and speed, respectively.

patterns have associative properties, in that they are made up of multiple entities; unlike hybrids, though, they do not result from a combination of previous classifications and therefore do not rely on such categorizations in the first place. Patterns do not exist in things themselves but only in relations between or among things. Second, patterns are inherent in the methods used to describe natural and artificial systems; therefore, they are specific to the theories underlying the philosophical and scientific developments that characterize systems thinking, yet broad enough to provide an overarching theme for looking at a wide range of methods and projects that employ patterns in distinct ways.

## Systems Thinking

Systems thinking swept through the sciences, humanities, and arts in the early twentieth century and remains central to many disciplines.<sup>5</sup> A system consists of any number of entities that interact with each other within defined spatial or temporal boundaries. As systems theorist Donella Meadows explains, "There are no separate systems. The world is a continuum. Where to draw a boundary around a system depends on the purpose of the discussion."<sup>6</sup> Systems have also been defined as "any pattern whose elements are related in a sufficiently regular way to justify attention," or as a "set of elements or parts that is coherently organized and interconnected in a pattern or structure that produces a characteristic set of behaviors."<sup>7</sup> Systems theory arose from biology with the development of general systems theory in the 1930s to 1950s (by Ludwig von Bertalanffy), and it was simultaneously developed in mathematics and cybernetics (by Norbert Wiener) and ecology (by the Odum brothers). Cybernetics—the study of control and communication in systems—exerted a particularly profound influence on ecology. Though the concept of ecosystems existed prior to the inclusion of cybernetic thinking in ecology, the coalescing of the two helped ecology to become a dominant science. Eugene and Howard T. Odum, the veritable forefathers of ecosystem study, pioneered the use of a notational language to study system behaviors, illustrating material and energy flows as if they were parts of an electrical circuit.<sup>8</sup> The flows were diagrammed as gains and losses that represented energy and organisms moving into and out of a particular ecosystem. The use of circuits as analogs for describing feedback loops provided ecologists with a tool for modeling biological processes in ecosystems as a whole, regardless of scale. This ability to schematize the overwhelming complexity of interactions was widely adopted, though it soon came under scrutiny for its mechanistic and reductive view of nature.

Early influential thinkers, including noted anthropologist and cyberneticist Gregory Bateson (*Steps to an Ecology of Mind*, 1972), extended the concept of systems and ecology to



11. Howard T. Odum created energy flow diagrams to model environmental systems visually. The symbols denote key characteristics of energy exchange in biological processes—source, loss, storage, production, and consumption—and lines denote pathways among these processes. The diagrams were used to develop mathematical equations for the system under study.





12. Logarithmic pattern of romanesco.

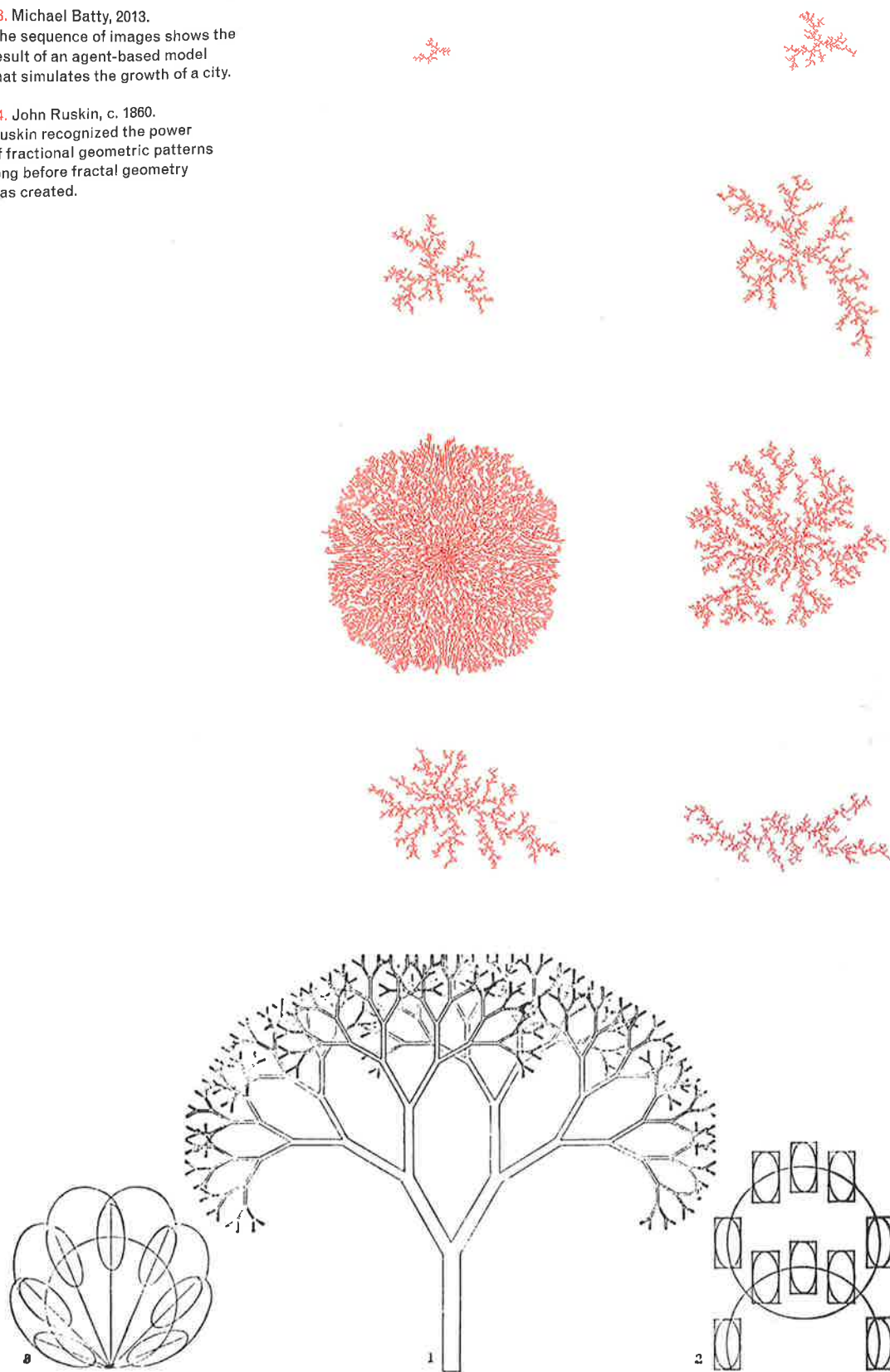
include all human relations, especially the problem of human communication and communication media.<sup>9</sup> Bateson was concerned that interpreting ecology through a purely material paradigm of energy flow and exchange would result in a mechanistic and quantitative view of humans' relations to nature and to each other.<sup>10</sup> He believed that ecology must be understood in terms not only of its material order but also its communicative order, that is, by the "patterns that connect" everything together, to use his oft-cited phrase.<sup>11</sup> For Bateson, ecological consciousness and patterns are inseparable.

This more inclusive understanding of systems provided a conceptual framework for dealing with the interconnectedness of a rapidly changing world. The shift occurred concurrently with growing awareness of global resource depletion, increasing pollution levels, and mounting population growth. This multi-scalar and interrelated understanding of the world was aided by ecology, biology, and physics, not simply because of what scientists were discovering about pollution (e.g., Rachel Carson's 1962 classic *Silent Spring*) or projecting about future population trends (Donella Meadows' 1972 work *The Limits to Growth*), but because new methods, including advancements in optical tools and the incipient phases of computation, made it possible to portray the dynamics of an ever-changing world.<sup>12</sup> Newfound environmental consciousness, abetted by NASA photographs of the earth from outer space, changed our collective image of the planet as well as our sense of humanity's place within it, as best summarized by the then-popular expression "spaceship earth." This broadening of the meaning of ecology and systems to encompass social, mental, and political domains, all integrated with environmental considerations, is widely taken for granted today.<sup>13</sup> Yet there remains a great deal of ambiguity and disparity of intent among designers seeking to import ecological concepts and systems thinking into design. This is not a problem in and of itself, but it is helpful to distinguish the different aims prevalent among designers who pursue this approach.



13. Michael Batty, 2013.  
The sequence of images shows the  
result of an agent-based model  
that simulates the growth of a city.

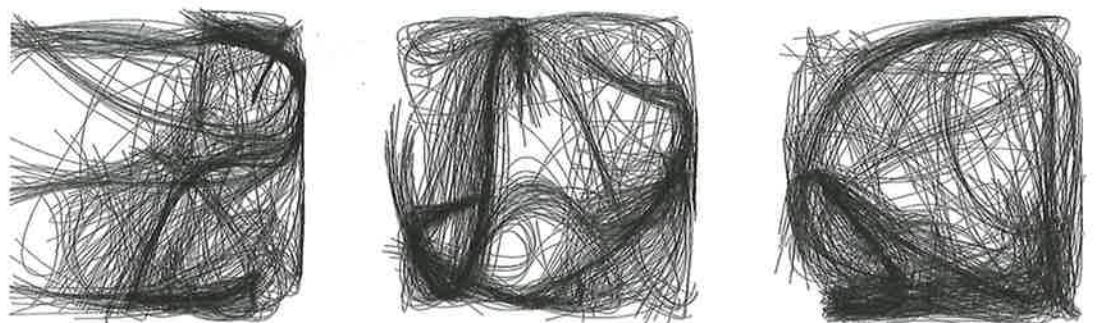
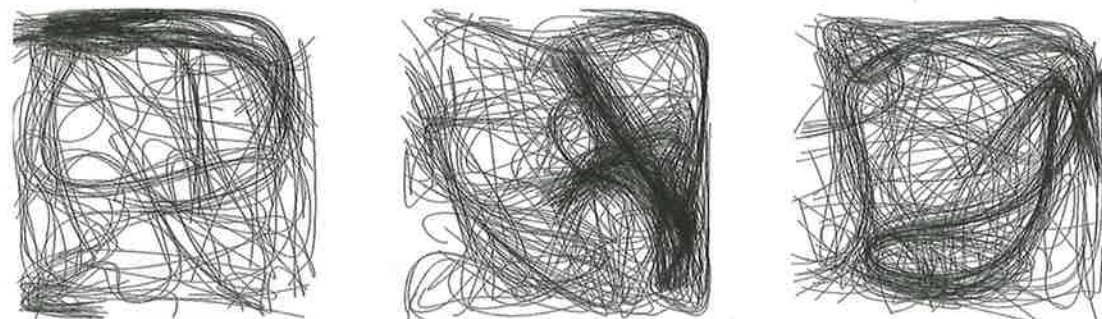
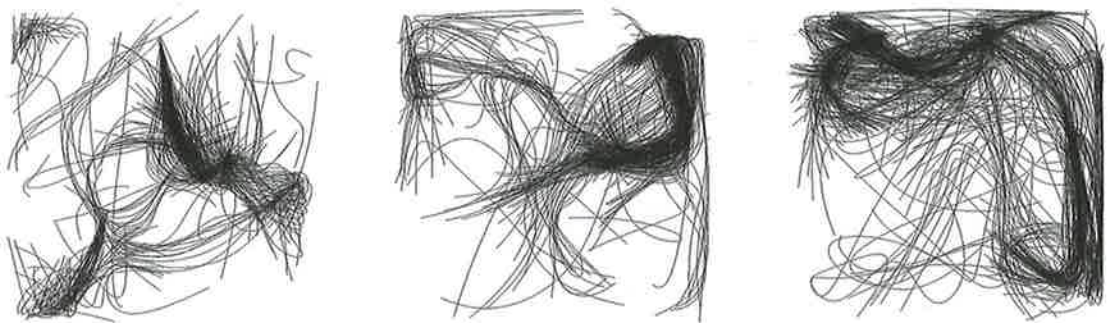
14. John Ruskin, c. 1860.  
Ruskin recognized the power  
of fractional geometric patterns  
long before fractal geometry  
was created.



## Systems and Ecology in Landscape Architecture

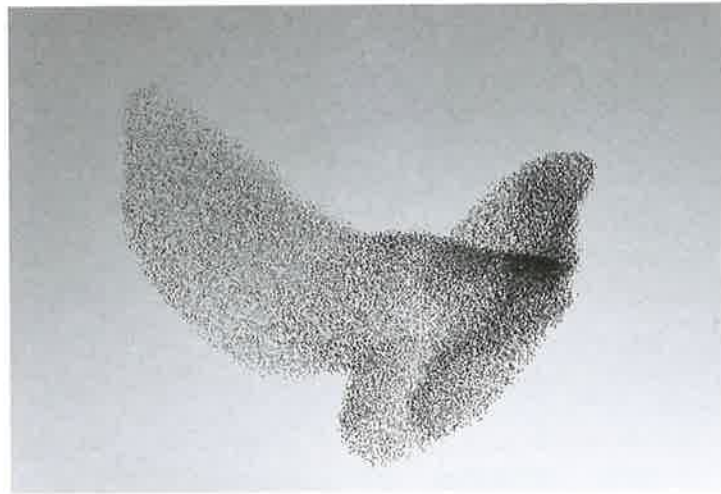
In the 1960s and 1970s, ecological principles and systems became increasingly relevant to theories and practices of the designed environment, as seen in the work of landscape architect Ian McHarg and others involved in regional planning. McHarg's adoption of the thermodynamic model to describe living systems was very much informed by the Odums' work on ecosystems, in which energy flow and feedback maintain systems in dynamic equilibrium, thus illustrating nature in balance. In contrast, the influence of cybernetics on landscape architect Lawrence Halprin's work, as well as on that of many artists of this era, involved different means and ends. Halprin's approach offered a way to think about systems that was not limited to interpreting them through the lens of natural science.<sup>14</sup> Cybernetics uses feedback loops wherein an action or event generates a change in the environment that is then fed into the system, causing a change in the system, and so on in cyclical fashion. Halprin drew on this concept to create a method of fostering participants' engagement in interactive design workshops. As these early examples demonstrate, systems thinking in landscape architecture has been interpreted in diverse ways, not all of which include direct engagement with natural systems. In fact, the interpretation of science by landscape architects had, and often still has, little to do with the scientific method, which is experimental in approach and provisional in its conclusions. Rather, their interpretation involves borrowing scientific concepts and a rigorous methodology as a means to substantiate land use and management decisions, as in McHarg's case, or expanding the methods by which designers engage participants in their environment, as in Halprin's case.<sup>15</sup>

As scientific paradigms change, so too do their interpretations in the design fields, and, as the above examples show, scientific concepts are interpreted in quite different ways. As McHarg, Halprin, and their contemporaries were developing design methods inspired by cybernetics, major developments in the sciences and mathematics coupled with improved computer technologies were radically altering





16. Photograph of a swirling flock of starlings, known as a murmuration. Shapwick Heath National Nature Reserve.



how the behavior of systems was understood. These developments led to the widespread study of self-organization and emergence, an approach that foregrounds the unpredictability and spontaneity of nature and represents a direct repudiation of the mechanistic view of nature in balance.

### Emergent Patterns

The shift from viewing ecosystems in thermodynamic terms to understanding them as more open and unpredictable began in the 1970s and led to a redirection of researchers' emphasis away from looking for stable patterns in dynamic equilibrium to looking for emergent patterns in self-organizing systems.<sup>16</sup> According to physicist Fritjof Capra, a chief theorist of systems thinking, the theory of self-organizing systems is the broadest scientific formulation of the ecological paradigm.<sup>17</sup> Research on self-organization happened not only in the biological sciences, but also in mathematics and physics with the development of fractal geometry and chaos theory, both of which describe emergent behaviors. Fractals are self-similar patterns across scales, created by repeating a simple process in a feedback loop, which eventually produces complexity. Chaos theory, colloquially known as the "butterfly effect," holds that a small initial input in a non-linear system can lead to much larger and more complex effects over time. This emphasis on self-organization also contributed more generally to the use of ecology as a metaphor, not only for the relatedness but also for the mutability of all things, marking a philosophical shift from *being* to *becoming*.<sup>18</sup> As with early cybernetics, the scientific and mathematical discoveries of emergence in natural systems were extended to the study of social systems and to the collective behavior of both humans and animals, a topic that we will address more fully in chapter 2.

Emergence refers to the behavior of complex natural systems, as well as to the computational modeling of such

processes. The increased modeling capacity of computers was critical to the advancements taking place in all scientific and mathematical fields of study. The ability to model emergent behavior was well established in these fields by the time these ideas made their way into design thinking, an event that coincided with the infusion of computers into design schools in the early to mid-1990s.<sup>19</sup> With these preoccupations came new departures in how patterns were understood and created. In architecture, for example, interest in emergent patterns in nature has inspired wide-ranging formal expressions, such as bio-morphology, or resemblances between human-made structures and natural structures, and emergent form, which uses genetic algorithms to "grow" formal variations from fixed parameters.

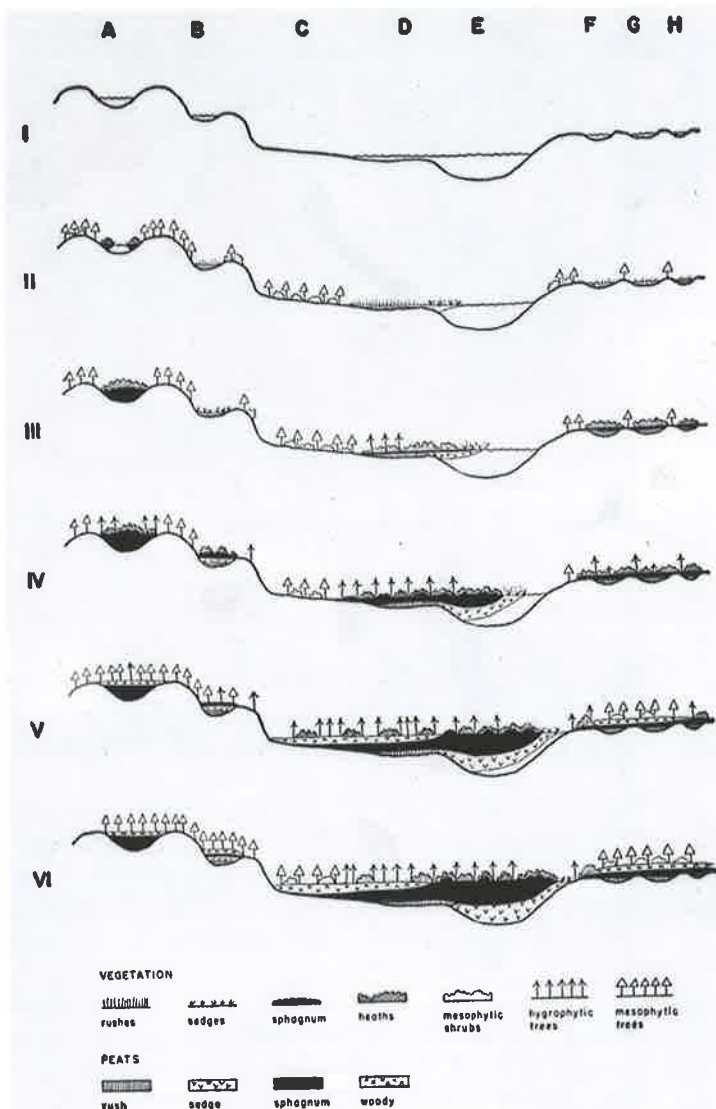
In landscape architecture, by contrast, emergence generally does not refer to formal variations produced during the design process but to material and cultural transformations that are presumed to occur *after* design implementation. As ecologist and planner Nina-Marie Lister notes, "A systems-based perspective of living systems rests on the central tenets of complexity and uncertainty, and necessitates flexibility, anticipation and adaptation rather than prediction and control in conservation planning and management."<sup>20</sup> Likewise, James Corner states that "a truly ecological landscape architecture might be less about the construction of finished and complete works, and more about the design of 'processes,' 'strategies,' 'agencies,' and 'scaffoldings' — catalytic frameworks that might enable a diversity of relationships to create, emerge, network, interconnect, and differentiate."<sup>21</sup> This notion of emergence presumes that, once the initial conditions have been set in place, ecological processes will unfold and the landscape will evolve toward a state of greater complexity.

A seminal moment marking the permeation of contemporary systems thinking into landscape design was the competition held for Toronto's Downsview Park in 1999. The framework for this competition drew explicitly on systems theory, and the notion of emergence formed the basis of several of the schemes selected as finalists. Julia Czerniak highlights



17. Henry J. Oosting, Laurentian Shield sphagnum bog succession diagram. Reprinted in Lawrence Halprin, *RSVP Cycles* (1969).

18. James Corner Field Operations, *Fresh Kills*, Staten Island, NY, 2001. Habitat phasing diagram.



# HABITAT PHASING



## GRASSLAND

Grassland is a community of herbaceous plants that grows in open areas. It is characterized by a high degree of productivity and a high degree of resilience. Grassland is a dynamic system that is constantly changing and evolving. It is a community that is highly adaptable to a wide range of environmental conditions. Grassland is a community that is highly resilient to disturbance and is able to recover quickly from damage. Grassland is a community that is highly productive and is able to support a wide range of wildlife and livestock. Grassland is a community that is highly resilient to climate change and is able to adapt to a wide range of environmental conditions.



## WOODLAND

Woodland is a community of woody plants that grows in open areas. It is characterized by a high degree of productivity and a high degree of resilience. Woodland is a dynamic system that is constantly changing and evolving. It is a community that is highly adaptable to a wide range of environmental conditions. Woodland is a community that is highly resilient to disturbance and is able to recover quickly from damage. Woodland is a community that is highly productive and is able to support a wide range of wildlife and livestock. Woodland is a community that is highly resilient to climate change and is able to adapt to a wide range of environmental conditions.



## LOWLAND FOREST

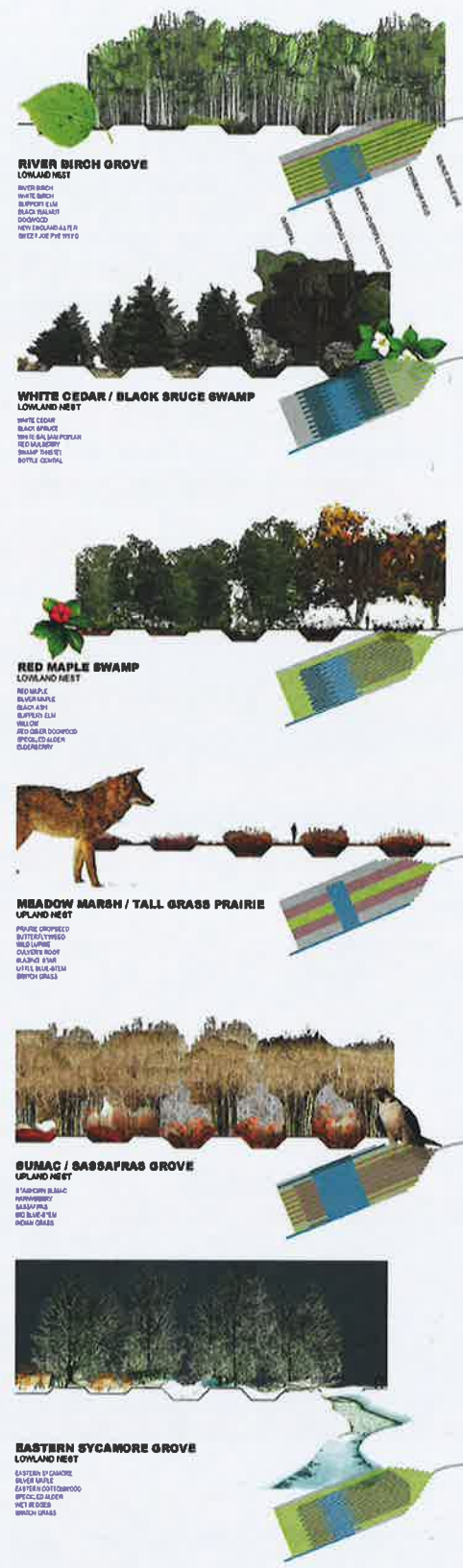
Lowland forest is a community of woody plants that grows in open areas. It is characterized by a high degree of productivity and a high degree of resilience. Lowland forest is a dynamic system that is constantly changing and evolving. It is a community that is highly adaptable to a wide range of environmental conditions. Lowland forest is a community that is highly resilient to disturbance and is able to recover quickly from damage. Lowland forest is a community that is highly productive and is able to support a wide range of wildlife and livestock. Lowland forest is a community that is highly resilient to climate change and is able to adapt to a wide range of environmental conditions.





19. Stan Allen and James Corner Field Operations, *Emergent Ecologies*, Downsview Park, Toronto, 1999. Planting strategy.

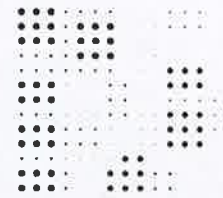
20. Bernard Tschumi/Dereck Revington Studio, *The Digital and the Coyote*, Downsview Park, Toronto, 1999. Planting succession diagram.



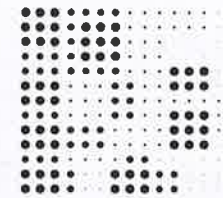
## TREES



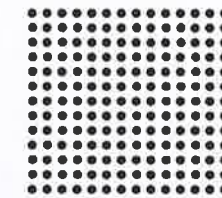
**0-5 YEARS**  
30% mature trees, 30% ball & burlap specimens, 30% seedlings at edge of zone



**5-10 YEARS**  
filling out of planted trees  
additional plantings in protection of  
developing trees



**10-15 YEARS**  
gaps between trees fill out and mature



**25 YEARS +**  
full maturation of savannah with  
25% tree coverage

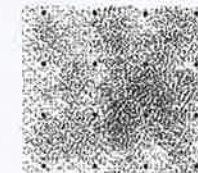
## PRAIRIE UNDERSTOREY



**year 1**  
plant plugs & seed mix away  
from trees



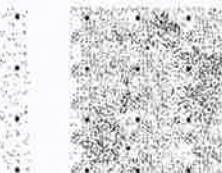
**year 2**  
prairie grasses & annuals emerge



**year 3**  
perennials emerge



**year 4**  
quadriennial burning of  
understorey



**year 5**  
cycle begins again

this fact in the introduction to her book *Case: Downsview Park Toronto*, in which she argues, "Emergence refers to the development of detectable patterns in information and belongs to both ecological and cybernetic theory."<sup>22</sup> In some of the proposals for the competition, such as those submitted by the teams led by Field Operations (*Emergent Ecologies*) and Bernard Tschumi (*The Digital and the Coyote*), patterns of growth and change were represented in phasing diagrams that illustrated a shifting landscape over time. The Field Operations scheme in particular relied on the repetition of similar ridges and furrows that would give rise to diverse habitats depending on their different water quantities, soil conditions, and maintenance regimes. This project exhibited the potential for patterns to demonstrate difference through the use of formal repetition, while remaining open to change through environmental interaction. In positioning its project, the team did not explicitly address this goal of difference within similarity in terms of what specific effects it might wish to convey, stating, "Geometry and form is [sic] less important for what it might mean or look like than for what it actually does."<sup>23</sup> The designers were primarily concerned with emergence as a material property of natural systems rather than with the perceptual differences that might arise from such processes. Although different habitats were illustrated as part of the design, it was unclear what particular relationships were structured among these habitats and whether it would matter if they did not evolve as represented — if, for example, all ridges and furrows evolved into very similar habitats or if they did not exhibit increasing plant and animal diversity.



The concept of emergence encompasses the notion that social systems are similar to natural systems, in that they evolve in unanticipated ways and thereby thwart our ability to plan their future development with any definitive ends in mind. This notion of emergence suggests a more bottom-up and flexible approach to design than that which master plans could be expected to offer. The winning Downsview Park scheme, *Tree City*, led by OMA/Bruce Mau, took this view of emergence to an extreme by proposing a diagram that was a-spatial, a-formal, and a-material. The designers simply recommended the quantities and types of programs that should occur, without any specificity as to where they should occur. The crucial design elements needed to support the potential evolution of the park, such as grading and planting, were neglected in favor of managerial organizations out of which the project would eventually evolve. In this example, systems thinking and its affiliated terminology of self-organization and emergence were interpreted in such a way as to equate the absence of a design "product" with indeterminacy and flexibility. In other words, this view of systems looked only at potential social organizations and not at formal and material ones or the potential relationships among all of these realms. Although one might argue that this approach challenges aesthetic norms by not providing any specific formal or spatial outcomes, the plan that resulted from this process was, unsurprisingly, a banal and uninspired landscape.<sup>24</sup> In other words, it challenged such norms by default and not through engagement with them, unlike OMA's earlier and more compelling Parc de la Villette proposal.

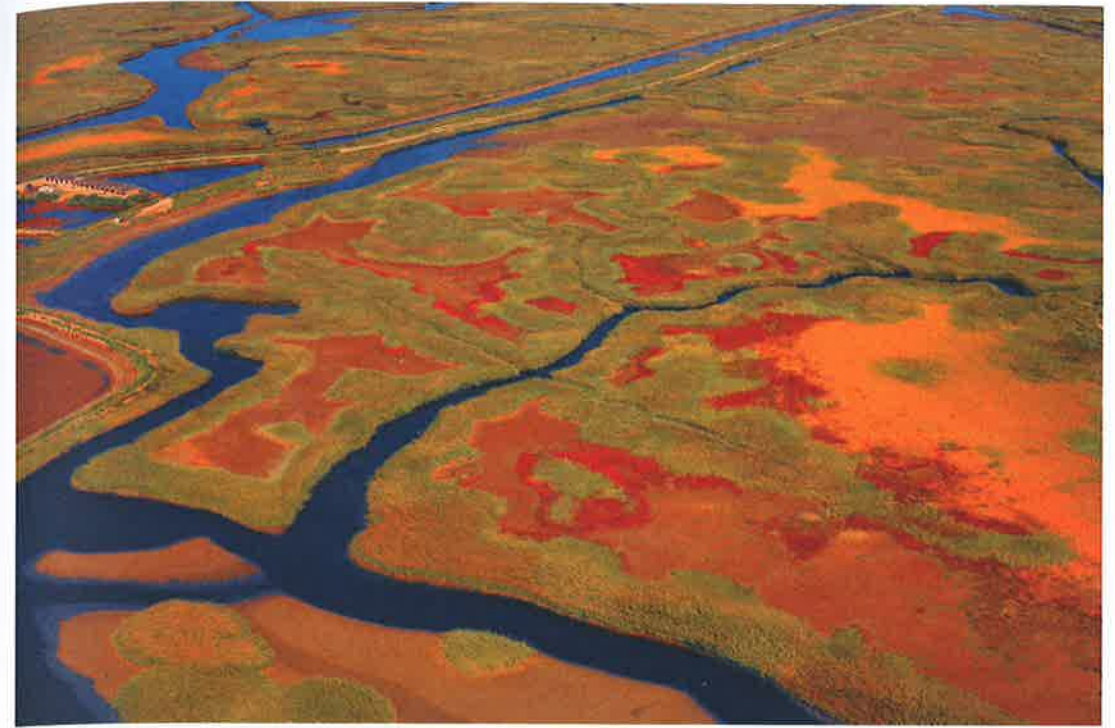
As the winning scheme for Downsview Park demonstrates, one interpretation of systems thinking has been a de-emphasis on form based on the conviction that it is too fixed and cannot account for emergence in systems. It follows from such a view that issues of subjectivity and experience are secondary or perhaps impossible to ascertain.<sup>25</sup> This latter point is characteristic of a more general trend in landscape architecture today, wherein systems thinking has focused on large-scale networks and infrastructures, such as energy, waste, and transportation. This approach, where systems are understood



21. Bruce Mau Design Inc., Petra Blaisse, Inside Outside; and Rem Koolhaas, Office for Metropolitan Architecture, with Oleson Worland Architects, *Tree City*, Downsview Park, Toronto, 1999. Site plan.

principally in terms of functions or material flows that can be measured or optimized, has great relevance for comprehending urban or regional patterns. These considerations do not, however, preclude addressing systems through an aesthetic framework, as we do here. This book highlights the conspicuous aspects of a system—the points at which it can be understood as both a pattern of relationships and *experienced* as such. The difference between the two approaches is that, in large-scale networks, patterns are comprehended primarily through maps and drawings, whereas in many of the examples shown in the following chapters, the designers' intention is to build an understanding of patterns into the realm of experience beyond two-dimensional representations. Following the latter approach, a landscape's "ecological" or infrastructural functions are seen *in relation to*, rather than *in preference to*, their appearance and how they function as signs.<sup>26</sup> Implicit in this approach to patterns is the belief that sensory and aesthetic functions should play a much larger role in defining an ecological ethos for landscape design, as they did briefly in the 1980s and 1990s among theorists and landscape architects, and even earlier, as seen for example in Halprin.<sup>27</sup>

The emphasis on a landscape's operational aspects over its formal and expressive characteristics has not been limited to this recent interpretation of systems thinking; it is also true of various approaches that characterized landscape architecture in the 1970s and 1980s. We have already compared McHarg's adoption of a thermodynamic model for describing systems with Halprin's more open interpretation of cybernetics. The range of interpretations of systems and science among designers is broad, and their relevance should be understood within the context of individual projects and circumstances; unfortunately, they are often understood as dichotomous and incompatible approaches to landscape. Although such clear divisions as those between art and science or between qualitative and quantitative determinants are oversimplifications that exist only in rhetoric, this dichotomizing logic is perpetuated and infiltrates our field to this day, as other landscape scholars have noted. The landscape architect Sylvia Crowe, for



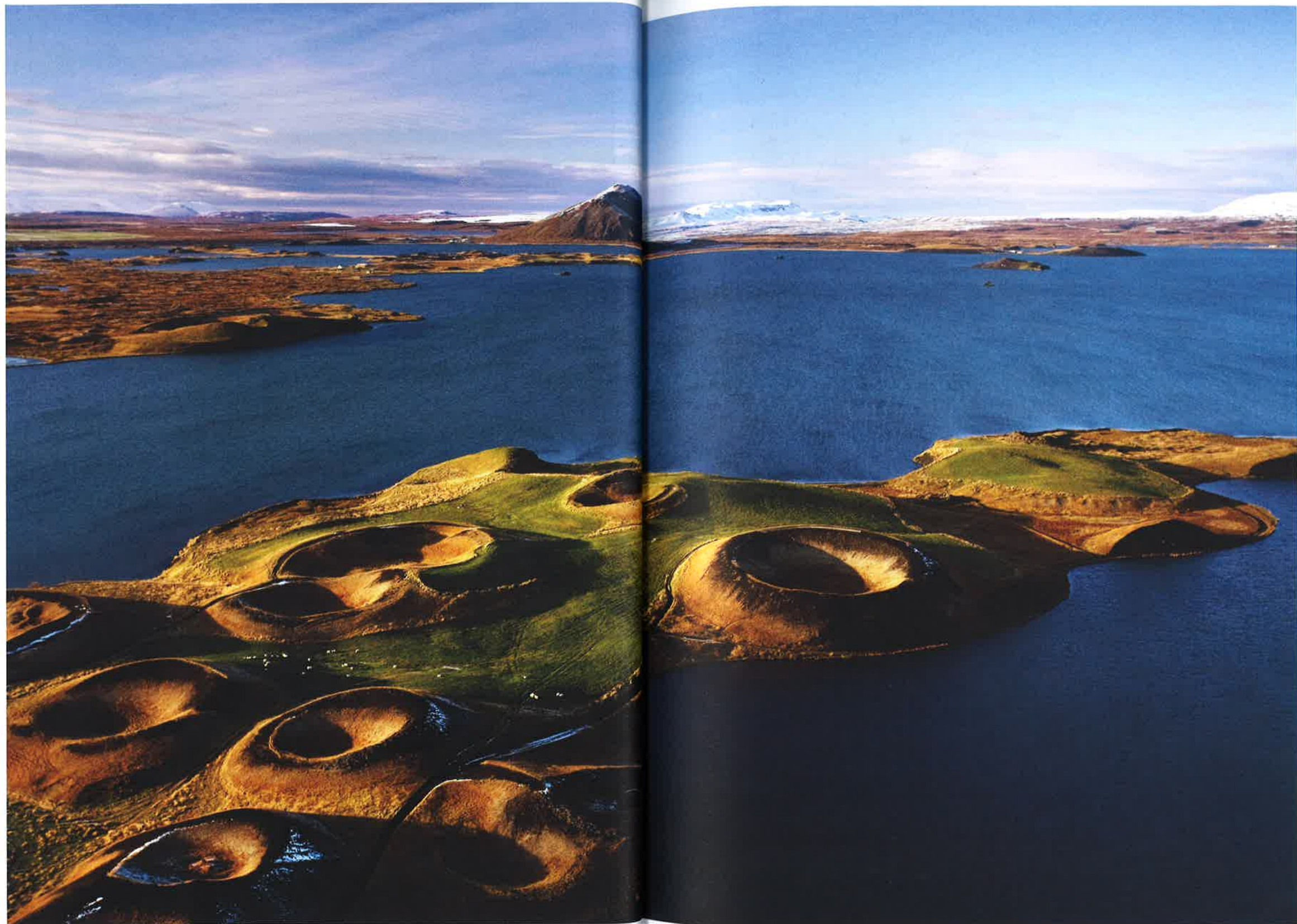
22. Panjin Red Beach salt marsh, Liaoning. The multi-colored zones are plants of the genus *Suaeda*, which turn vivid shades of red in autumn.

example, who later co-authored *The Pattern of Landscape* (1988), defined landscape architecture in 1957 as a profession that aims to mend the "breach between science and humanism, and between *aesthetics* and *technology*" (emphasis added).<sup>28</sup> Likewise, Margot Lystra draws attention to the skirmish between Garrett Eckbo and Neil Porterfield in 1969–1970 in which Eckbo criticized environmental design approaches as suffering from "analysis paralysis," whereas Porterfield chided spatial designers as purveyors of "fantasy fatigue" who justified rearranging large areas of land by claiming artistic license.<sup>29</sup> Lystra quotes a similar statement by McHarg, who claimed that ecology offered emancipation to landscape architecture and that "the caprice and arbitrariness of 'clever' designs can be dismissed forever."<sup>30</sup>

In *The New Landscape in Art and Science* (1956), György Kepes cautioned against these distinctions, criticizing a perspective that, in his view, devalued art by positing that an entity's quantitative aspects are to be trusted because they are "real," whereas subjective and sensory experiences are to be suspected. Kepes argued that this "leads quite logically to a value judgment favorable to science and unfavorable to art."<sup>31</sup> On the contrary, the two realms are inseparable. Interpreting systems thinking primarily in terms of material and energy flows obscures the broader understanding of ecological consciousness called for by Bateson, Crowe, Kepes, and others. Patterns can bridge the divide between science and art by providing a link between material and experiential realms.

> 23. Myvatn Lake in Iceland is the result of a lava eruption that occurred over 2,000 years ago. These circular shaped pseudo craters resemble volcanic craters but lack a vent for magma.

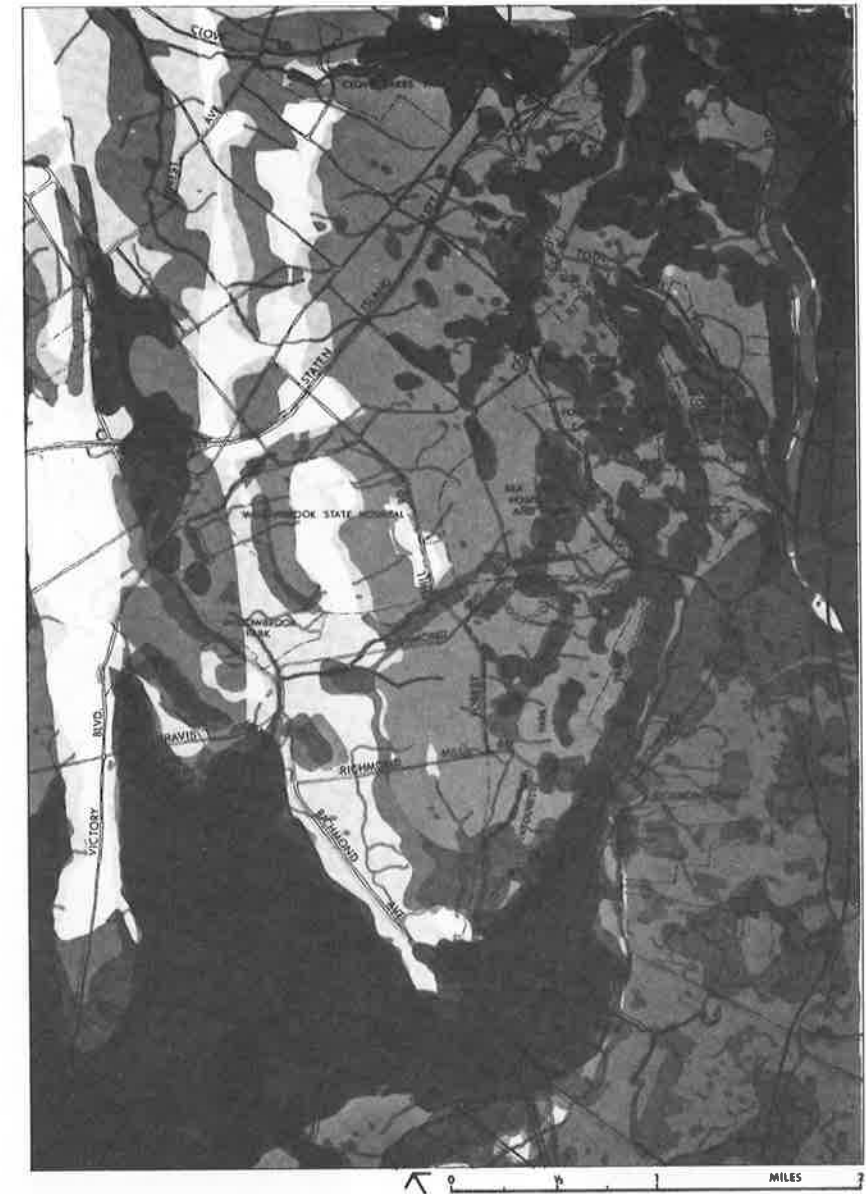




### Analytic Versus Applied Patterns, or "Fitness" Versus "Flatness"

The above discussion has briefly sketched how systems thinking has been broadly interpreted in landscape architecture. In this section, a comparison between McHarg and Walker will help us to grasp more clearly how patterns have been employed in the recent past and how the latest forms of pattern both diverge from and build on these distinct approaches. Although the ideological differences between McHarg and Walker are clear and their practices are radically distinct, they share a key concern, in that an attention to pattern is evident in the methodologies of both designers. The use of new media can facilitate the recognition of connections between their two approaches to pattern, enabling pattern-finding while also making possible new kinds of pattern-forming.

McHarg developed a systems approach to land-use planning, studying correlations among various extant landscape patterns using a layered mapping technique, a precursor to digital Geographic Information Systems (GIS). McHarg mapped each layer of a physical system, such as its topography, vegetation, and built forms, onto a transparent sheet with various tones. Each layer was drawn as a gradient from dark to light, with dark representing the greatest degree of restrictions for a particular design factor. To identify the best location for a road, for example, the topography would be toned to show the steepest areas as dark gray and the flattest areas as white, with the presumption that the flatter condition is more suitable for a road. This process would be repeated for each individual layer of the landscape, such as soil type, vegetation cover, and bodies of water. When these transparent images were superimposed, the composite map "revealed" the areas with the least amount of restrictions; that is, the areas on the map with the least amount of cumulative tones were considered best suited for a particular type of development. McHarg believed that his purportedly objective mapping procedure would guide all designers to the same outcomes and that the computer would facilitate this method. He declared that the "computer will solve the



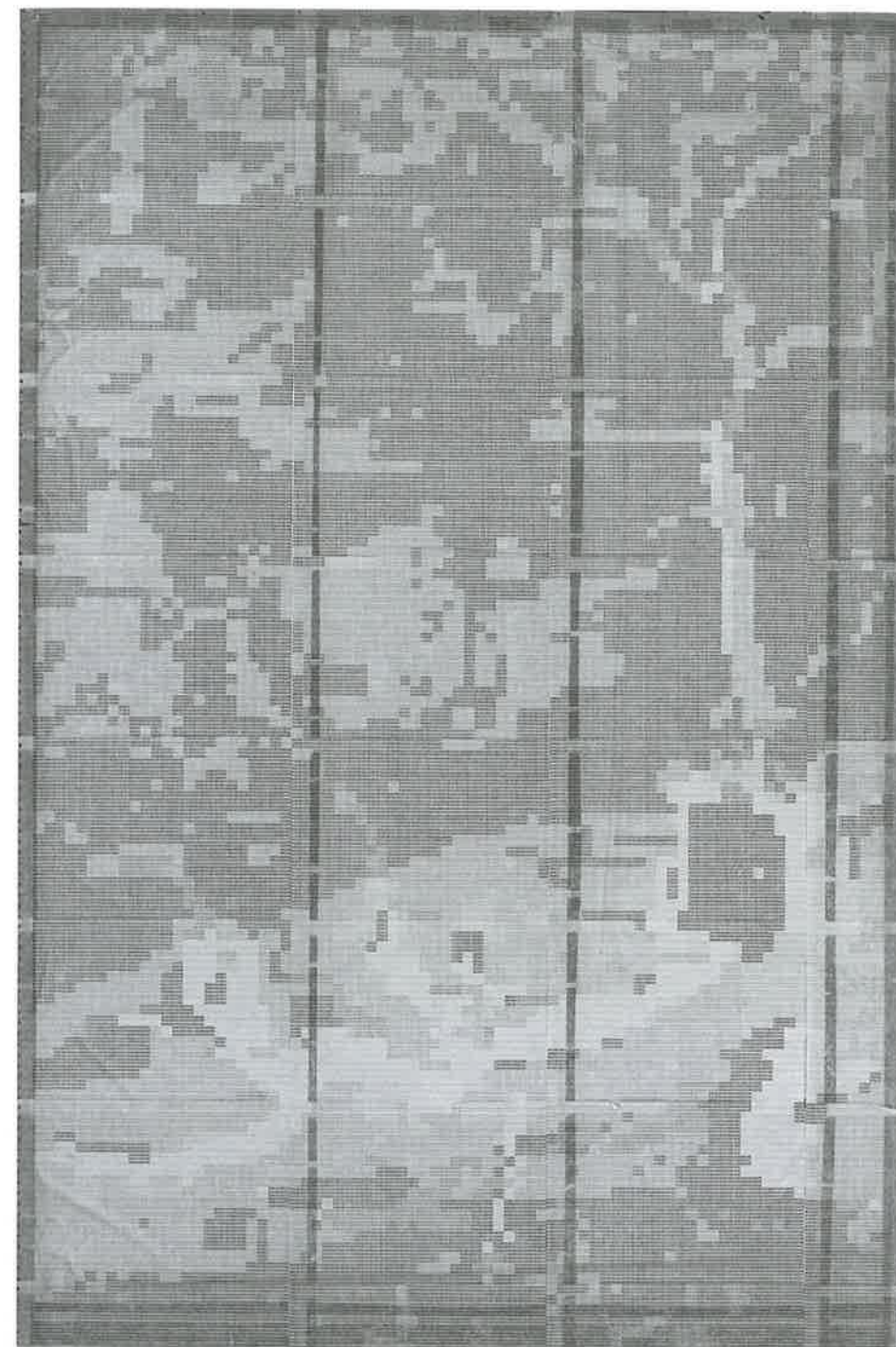
24. Wallace, McHarg, Roberts, and Todd, *Richmond Parkway Study*, 1968–70. Mapping of physiographic obstructions in order to determine road alignment.

> 25–26. Ian McHarg, *Delaware River Basin IV, Piedmont Upland Study*, 1969–70. Base topography map (left) and computer plot of agriculture suitability (right).

command 'show me those locations where all or most propitious factors are located, and where all or most detrimental factors are absent.'

The study of existing patterns as a means to direct new ones is sensible for obvious reasons, especially when one is determining how best to align land-use patterns with natural characteristics, as McHarg was attempting to do. Although his mapping procedure produced ample information, this information fell victim to conventional landscape imagery and forms when translated into design proposals.<sup>33</sup> McHarg failed to construe what an exploration of patterns might mean for experiential or spatial organization at specific sites, rather than only for land-use planning.





PIEDMONT UPLAND  
D.R.B. IV

AGRICULTURAL SUITABILITY 01

- ☐ PRIME
- ☐ SOME LIMITATIONS
- ☐ MANY LIMITATIONS
- ☐ SEVERE LIMITATIONS
- ☐ NOT SUITABLE



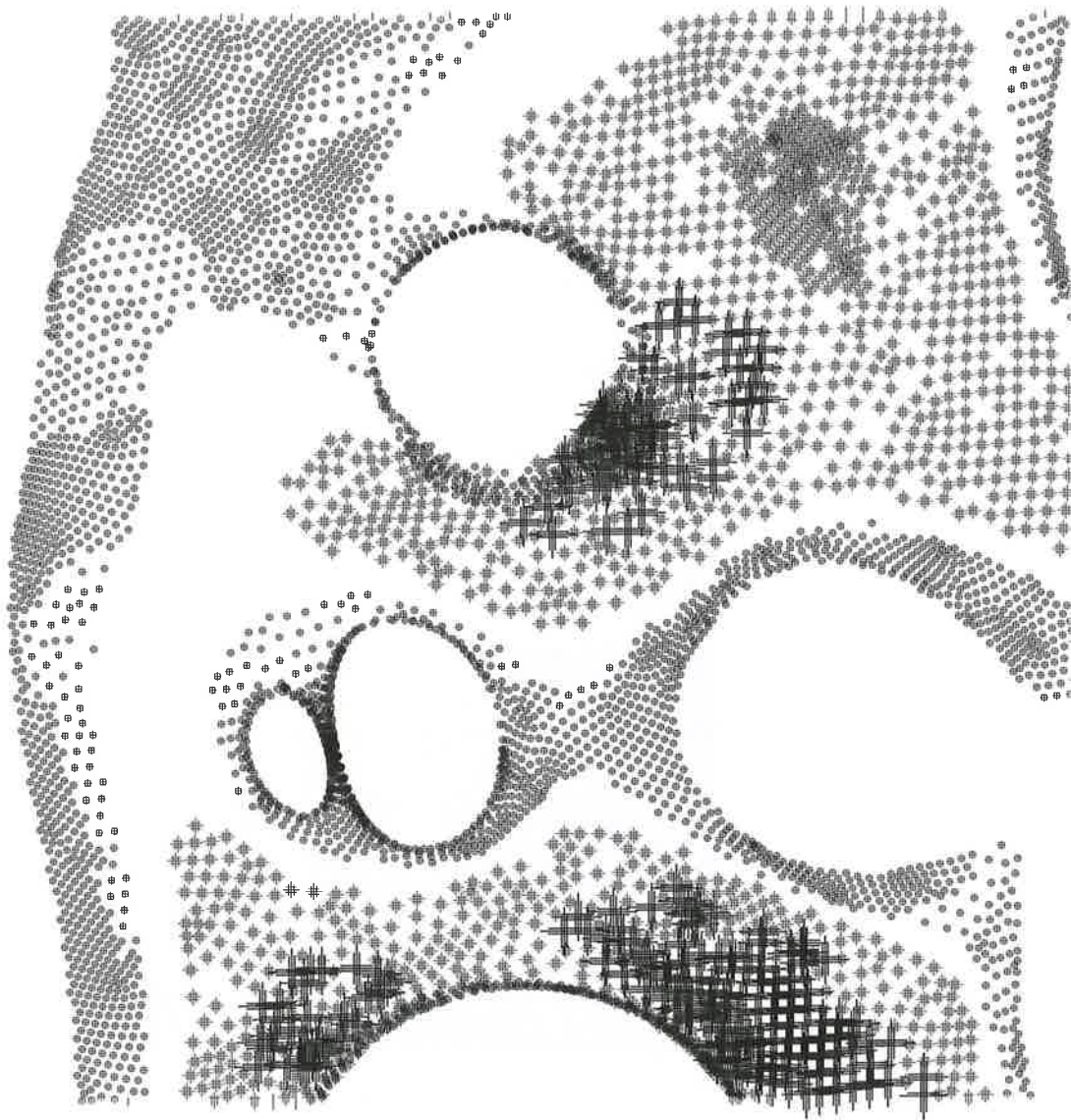
In contrast to McHarg's layering method, which uses pattern-finding and analysis to determine fitness for land use, Peter Walker's layering method overlaps multiple simple geometric patterns. Eschewing a purely analytic approach, Walker turns instead to the tactics of gesture, seriality, and flatness in order to make landscape visible as "the thing itself."<sup>34</sup> Concerned that design has become too dependent on analysis, Walker seeks to articulate landscape's constructed nature through the deployment of visible patterns—for example, by layering planes of stone, grass, and water using a technique of formal repetition. Walker and others who promote this approach to patterning argue that it amplifies our ability to read the landscape as an intentional fabrication rather than as benign background, thereby prompting people to reflect on its significance. Critics, however, argue that geometrical patterns are autonomous and therefore unable to reflect the particulars of each site. For example, Marc Treib uses the work of Walker, alone and in collaboration with Martha Schwartz, to exemplify how patterns are limited to visual effects.<sup>35</sup> Treib equates pattern-making in landscape design with superficiality, maintaining that an ecological approach is "deeper," although by this term he is clearly not referring to a McHargian ecological approach.<sup>36</sup> Rather than using "structure, space, and pattern as content," Treib maintains that "deeper works may result from using these vehicles to embody other types of content, among them the understanding and judicious application of ecological processes."<sup>37</sup> In this statement, Treib suggests that patterns might be a vehicle for revealing landscape processes, but his argument generally limits a pattern to that "which begins and ends as a flat surface."<sup>38</sup> As this example demonstrates, the skepticism about designed surface patterns in landscape architecture derives from the belief that these patterns reflect excessive control over living matter. Uniformly ordered patterns are seen as inadequate for the task of representing our current understanding of landscapes as dynamic and fluctuating.



27. Peter Walker and Partners, *Oyama Training Center*, Japan, 1993.

28. Peter Walker and Partners, *Hotel Kempinski*, 1994.



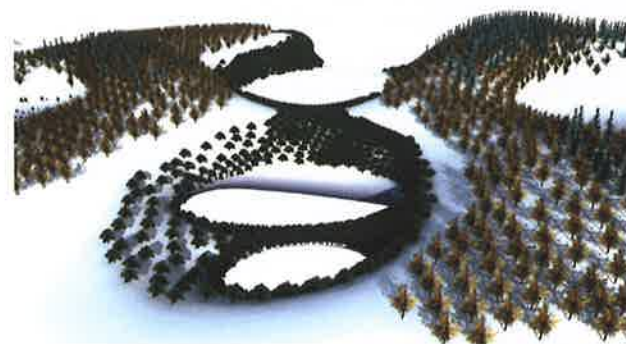







## Patterns that Connect

As soon as people become aware that they contribute actively to their own perception, they become much closer to the world around them.<sup>39</sup>  
— Peter Harries-Jones

Though patterns in landscape architecture have often been affiliated with surface geometries or superficial applications, certain theorists have recognized their broader significance.<sup>40</sup> The main purpose of Simon Bell's comprehensive treatment in *Landscape: Pattern, Perception and Process* (1999) is to examine the role of patterns at the scale of ecosystem management.<sup>41</sup> One of the primary theorizations of the association between patterns and processes in landscapes has come through the field of landscape ecology, which deals with flows and movement in relation to spatial structure. Landscape ecologists catalogue landscape patterns into spatial characteristics, such as small patches, large patches, and corridors. They then correlate specific ecological attributes, such as species richness, to those spatial characteristics in order to determine how to protect key habitats and to direct development toward less ecologically significant areas.<sup>42</sup> Bell defends the importance of patterns in both functional and aesthetic terms. He argues that land management procedures must fit the landscape's underlying structure—its given patterns—as well as address the aesthetic dimensions of the human-made patterns that are superimposed on that structure. Our book also aims to find links between pattern-finding and pattern-forming, but we do so by looking primarily at projects that are located in urbanized areas and are not part of large-scale managed landscapes.

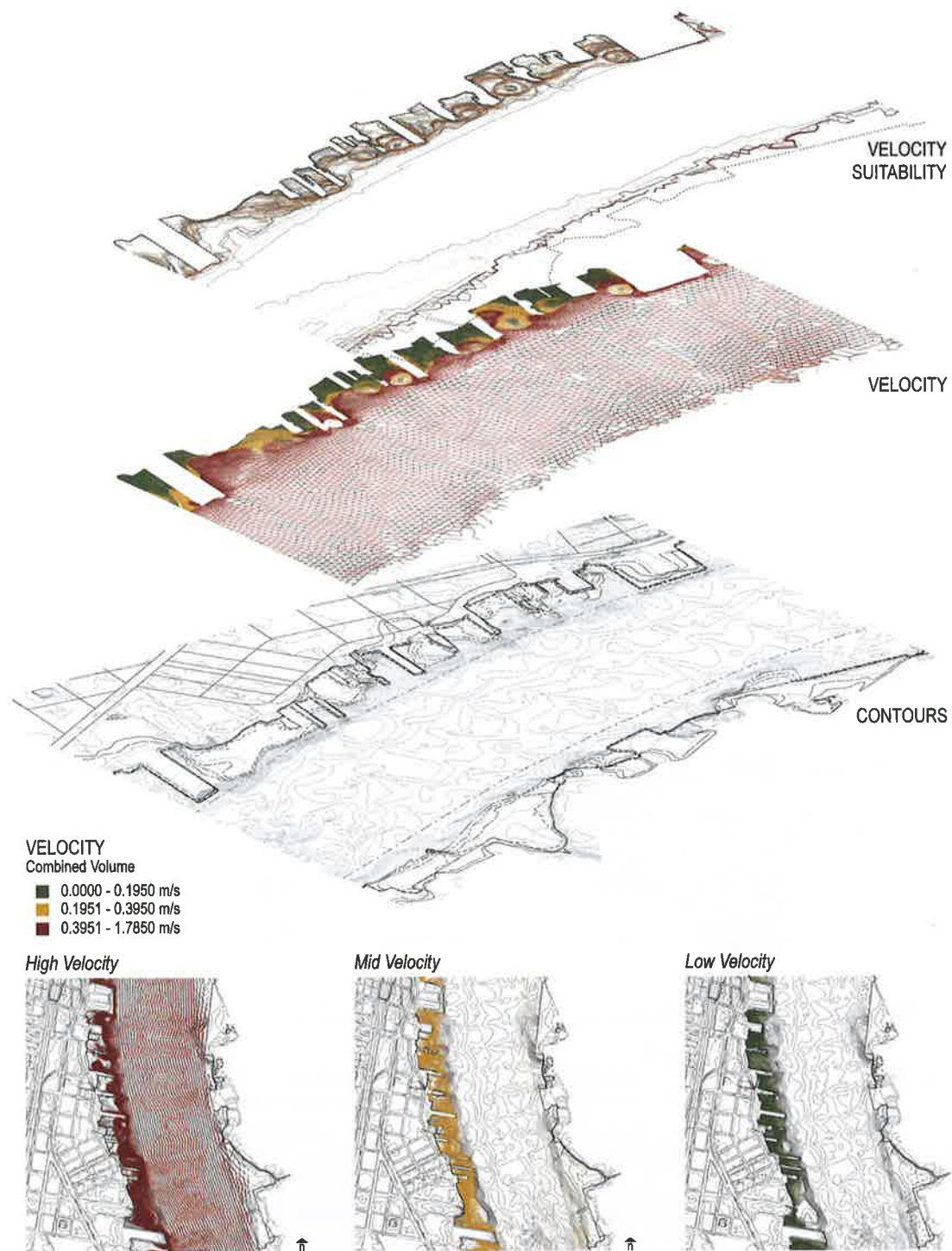
More akin to our exploration is the argument made by Anne Whiston Spirn in her article, "The Poetics of City and Nature: Towards a New Aesthetic for Urban Design" (1988). Spirn supports a view of ecology that celebrates aesthetic, subjective engagement with natural processes by considering ways in which these processes are incorporated into the



Plant Community Species	"FloraPropagation" relative variables
 Bodie Sage	species #1 spacing = .003 min elevation = +10 max elevation = +25
 Silver Buffaloerry	species #2 spacing = .006 min elevation = +30 max elevation = +50
 Narrowleaf Willow	species #3 spacing = .009 min elevation = +40 max elevation = +60
 Alkali Saltbush	species #4 spacing = .015 min elevation = -25 max elevation = +10
 Desert Mahogany	species #5 spacing = .030 min elevation = +10 max elevation = +30

29. Chia-hua Liu, 2006. Parametric model visualization using algorithms to explore plant distribution and density based on slope, aspect, and soil type.





30. PEG office of landscape + architecture, Philadelphia, 2015. Hydrodynamic simulation of a portion of the Delaware River using Aquaveo SMS and Grasshopper.

design of urban environments. Though Spirn does not address landscape pattern directly, it is an important sub-theme of her argument that she supports with images of patterns produced by radio frequencies and planetary orbits, among other sources. Spirn notes the importance of patterns formed by natural processes and suggests that they are a potential source for design: "Recent developments in mathematics and science afford new insights into the geometry and aesthetics of form generated by dynamic processes, be they natural or cultural, and point to new directions for design."<sup>43</sup> Furthermore, Spirn cites Gregory Bateson's notion of "patterns that connect" across time and scales, an idea of particular relevance because it overcomes the dualism of seeing patterns in terms of their environmental functions versus creating patterns for aesthetic reasons.<sup>44</sup> Advances in digital technology and imaging have augmented this potential significantly since Spirn's essay first appeared. With the development of parametric software, computer-controlled tools such as those used for 3D milling and printing, and access to geospatial technologies such as satellite imagery, digital elevation models, and computer fluid dynamic (CFD) models, it is possible to understand and imagine increasingly complex patterns.

Whether patterns are understood as emergent, analytical, or compositional in nature, the various approaches outlined above all share a similar ambition, which is to identify relationships between natural and cultural domains. Patterns are vehicles for rendering processes comprehensible; form, composition, and repetition are means by which what is fluid and changing becomes perceptible. As Spirn notes, recurrences are necessary because without them "time would be an imperceptible, formless flow."<sup>45</sup> Likewise, Bateson scholar Peter Harries-Jones states that it is difficult to understand change without a point of reference; understanding "requires some form of sense or instrument which will indicate patterns of *both* change *and* not-change."<sup>46</sup>

Accordingly, we focus in this book on techniques that utilize formal or temporal recurrences in order to convey



environmental recurrences. In doing so, we respond to Bateson's assertion that it is "of prime importance to have a conceptual system which will force us to see the 'message' (e.g. the art object) as *both* itself internally patterned *and* itself a part of a larger patterned universe."<sup>47</sup> Addressing both ends of the spectrum—the perceptual and the material—is critical to developing an ecological consciousness capable of overcoming the dualisms that have often plagued discussions in landscape architecture since the discipline's adoption of the ecological mandate. As architectural historian Christopher Hight so eloquently states:

[The] aesthetic is interwoven into the history of discourses of the environment and the production of ecological concepts, such that an ecological design ethic is not detachable from its formal, graphic, and spatial concepts. This does not produce harmony between Nature and Culture, but brings the inhuman into the realm of our senses and sensation, and constructs alternative assemblages between processes and forms.<sup>48</sup>

As the ideas and projects presented in the following chapters demonstrate, patterns are one way to consider such alternative assemblages. Patterns can link the ecological and infrastructural mandates placed on landscapes without forsaking formal and perceptual coherence. This approach follows in the footsteps of Bateson's ecological episteme, which is rooted in recursive communication that attempts to link the natural and cultural realms.<sup>49</sup>

