



INVESTIGACIÓN

Building Up; Wearing Down Entropy, Erosion, and Expansion

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Abstract

Designers and critics tend to focus on the construction of landscape architecture rather than on the effects of entropy upon it. It is entropy, in fact, that shapes landscapes and creates ruins after the landscape designer has left the scene. The moss that now blankets the surfaces of Saiho-ji in Kyoto—the so-called “moss temple”—invaded the uncovered terrain of this fourteenth-century temple grounds. It was not planned, but accompanied the passage of time and the intrusion of vegetation. In contrast, the French formal garden attempted to dispel the effects of entropy and time to some degree, in a constant battle of aspiration against the effects of growth and decay.

Entropy and the forces of nature erode our initial efforts at making—whether they are landscape or architectural—leaving what remains to use in a new way, or for us to consider in a new way. In time, we may come to understand that nature is dynamic, with neither climax nor steady state. Stopping time and entropy is impossible, although it may be temporarily stilled with continued and costly efforts that may not be sustainable. Perhaps an appreciation of entropy will help us create landscapes marked by a dynamic equilibrium that evolves under new pressures and agents—including the agents of entropy.

Keywords: entropy, erosion, expansion, landscape architecture

Resumen

Los diseñadores y críticos tienden a enfocarse en la construcción de la arquitectura de paisaje sin tomar en consideración el efecto de la entropía en ésta. La entropía es de hecho, la que da forma al paisaje al crear ruinas después que el diseñador de paisaje deja la escena. El musgo que ahora cubre como un manto la superficie del Saiho-ji en Kyoto, llamado Templo del Musgo, ha invadido poco a poco el terreno en el cual se asienta el viejo templo del siglo xiv. Esto no fue planeado, sino resultado del paso del tiempo y la intrusión de la vegetación. En contraste, el jardín francés formal trata en cierta medida de contrarrestar los efectos de la entropía y el tiempo, en una batalla constante deseando neutralizar los secuelas del crecimiento y el deterioro.

La entropía y las fuerzas de la naturaleza van erosionando nuestras creaciones y esfuerzos originales, ya sean en arquitectura de paisaje o arquitectura, y dejan los remanentes para usar en nuevas formas, o para ser consideradas con una nueva visión. Con el tiempo, podemos llegar a entender que la naturaleza es dinámica, sin un clímax ni un estado constante. Detener el tiempo y la entropía es imposible, aunque puede ser temporalmente demorado con esfuerzos continuos y costosos, siendo pocas veces sostenibles. Tal vez apreciar la entropía nos ayude a crear paisajes con equilibrio dinámico que evolucione bajo nuevas presiones y agentes, incluyendo los efectos mismos de la entropía.

Palabras clave: Entropía, erosión, expansión, arquitectura de paisaje

On visits to the beach, as children and even as adults, we pile and mold sand to make structures simple, fanciful, or complex. The material is free, as is our time. While our efforts and the degree of detail and intricacy vary with each attempt, common knowledge cautions us that with waves or a rising tide our constructions will surrender to the forces of entropy. All our construction in sand will vanish, returning to its original state as beach and shoreline. The process is unyielding, the lesson undeniable: without constant vigilance and care what has been erected will ultimately fall. This is entropy, a law that affects architecture, landscape design, and the land itself.

Entropy is defined scientifically as “a measure of the unavailable energy in a closed thermodynamic system that is also usually considered to be a measure of the system’s disorder,” or more broadly as “the degree of disorder or uncertainty in a system.”¹ Within the context of landscape architecture, however, I will suggest a second, more generally held definition that considers entropy as the sustained degeneration of apparent order until a state of uniformity is achieved. The psychologist and art historian Rudolph Arnheim qualified this state as one of disorder, defining order in this way: “[O]rder is described as the carrier of information, because information is defined as the opposite of entropy, and entropy is a measure of disorder.”² However, this state of ultimate homogeneity—like the homogeneity of the sandy shoreline—can be considered as order rather than disorder, although it certainly does reflect a degradation of an ap-

¹ Webster’s Ninth New Collegiate Dictionary, Springfield, Mass.: Merriam Webster, 1986, p. 416.

parent order imposed by human beings.³ At least two paths lead to homogeneity. The first follows the path of degradation, as in the erosion of land; the second traces the expansion of systems, whether inert or living. Both these processes—of degradation and expansion—manifest a similar tendency towards homogeneity. Considering the proliferation of living systems such as weeds and mold as examples of entropy might be stretching its accepted definition, I must admit. To justify my grouping of these two tendencies I would use a mathematical simile, proposing that spreading is a *corollary* to the basic *axiom* of entropy. Unlike an axiom, a corollary can not be proved; its validity follows naturally from the axiom, in this case the notion of entropy as degradation.

Ultimately, we must ask of what relevance to the practice of landscape architecture are ideas of degradation and expansion? Beyond the conditions of any particular landscapes, both are concerned with ideas of process and ideas of time: Not a certain place fixed at a certain moment, but a certain place as a moment in an inexorable flow of process. Contemplating entropy coerces us to think beyond the moment of conception, the moment of installation, the moment of inhabitation.

In the closing years of the 1960s, the sculptor Robert Smithson explored the

processes of entropy and their effect on the natural and built environments—and on the making of art. To Smithson, as a self-proclaimed “dialectician”, entropy as represented in nature was “*indifferent* to any formal ideal” [italics in the original]. In his essay “Frederick Law Olmsted and the Dialectical Landscape” Smithson also suggested a basis for the picturesque aesthetic in both nature’s expected and unexpected conditions.⁴ To the artist the rubbish and squatters that once occupied the site of Central Park equaled in interest the maintained lawn of the Sheep Meadow, while the Ramble in its overgrown and derelict state had become an “urban jungle” and tantalizing as such.⁵ In no better condition was The Pond, “aswirl with oil slicks, sludge, and dixie cups.”⁶ How should one approach this site, a public landscape that had succumbed to entropy? “The mud should be dredged out,” wrote Smithson. “This maintenance operation could be treated in terms of art, as a ‘mud extraction sculpture.’”⁷

In a series of works, as in his writings, Smithson theorized and tested the irreversible effects of gravity and mixture, and the effects of entropy on human constructs. His *Asphalt Rundown*, executed in Rome in 1969, was the most visible of these projects.⁸ By pouring the molten contents of a dump truck over the side of a ravine outside Rome, Smithson marked the path

² Rudolph Arnheim, *Entropy and Art: An Essay on Disorder and Order*, Berkeley: University of California Press, 1974, p. 15. For Arnheim, disorder is not the lack of order but the conflict of contrasting orders.

³ Marc Treib, “Traces Upon the Land: The Formalist Landscape” (1979), reprinted in Marc Treib, *Settings and Stray Paths: Writings on Gardens and Landscapes*, London: Routledge, 2003, pp. 26–51.

⁴ Robert Smithson, “Frederick Law Olmsted and the Dialectical Landscape” (1973), in Jack Flam, editor, *Robert Smithson: Collected Writings*, Berkeley: University of California Press, 1996, pp. 157–174.

⁵ *Ibid.*, p. 169.

⁶ *Ibid.*, p. 171.

⁷ *Ibid.*

⁸ On *Asphalt Rundown* see Robert Hobbs editor, *Robert Smithson: Sculpture*, Ithaca, NY: Cornell University Press, 1981, pp. 174–175; Suzaan Boettger, *Earthworks: Art and the Landscapes of the Sixties*, Berkeley: University of

of the spill over the land. The work involved a double commentary, given that before blanketing them completely the asphalt first occupied gullies in the slope caused by erosion.⁹ From that point on, nature would take the controlling hand, presumably effacing the identity of the asphalt over time as it mixed with the soil. Smithson further explored these ideas in related works such as the *Partially Buried Woodshed*, executed on the campus of Kent State University in 1970. Here the artist loaded the small building with earth until its support structure began to crack. From that point on, the work was left to endure environmental forces, gravity, and entropy.¹⁰

Entropy is not reversible. Adding black paint to white paint, and blending the two colors together, creates gray. Reversing the direction of the stirring, however, will not separate the gray paint into its constituent black and white: it will remain gray.¹¹ In their works contemporary artists have exploited the processes of entropy more fully than landscape architects and have also tested its law of irreversibility. The sculptors Mona Hatoum and Alice Aycock, for example, have created works of sand that question the possibility of erasure, underscoring the temporality of the artwork, and by extension, perhaps our own very existence. Hatoum's *+and-* (1994–2004) creates and destroys, draws and erases,



Aycock, *Sand/Fans*

in a continuing process that both accepts and thwarts the process of entropy. In Alice Aycock's *Sand/Fans* (1971) four rotating fans turn in uncoordinated arcs that incessantly reshape the profile of the sand pile and focus attention on the impact of conflicting entropies. While small in scale, both these artworks suggest, for example, how entropy might guide the formation of dune landscapes or land reclamation efforts at larger scales.

Of the landscape architects practicing today, perhaps it is Georges Descombes

California Press, 2002, pp. 198–199; and Eugenie Tsai and Cornelia Butler, Robert Smithson, Los Angeles: Museum of Contemporary Art, 2004, pp. 182–183.

⁹ Smithson used the vehicle of the pour in several works including *Hot Asphalt-Earth* (1969), *Mud Flow with Mirrors* (1969), and *Glue Pour*, Vancouver (1969).

¹⁰ "As part of the gift, the University's Art Department had to accept the work as permanent and agree not to alter it or remove anything from it or from the forty-five-foot surrounding area, although Smithson considered natural alternations to be part of the work." Ann Reynolds, Robert Smithson: Learning from New Jersey and Elsewhere, Cambridge, Mass.: MIT Press, 2003, p. 195.

¹¹ Of course, rocks may erode into sand and then be reformed as rock under the pressures of metamorphosis. But this is not a reversible process, but a new one again informed by entropy.

who has looked most carefully at the nature of the site as the basis for his interventions, while at the same time acknowledging the ephemerality of those interventions as they endure entropy. In his design for the 1991 *Swiss Way* Descombes engaged the site by examining and assessing—and at times repelling—the degradation that for centuries had shaped this two-kilometer-long path around Lake Brunnen.¹² Where the edge of the road had been eroded by rain and wind, Descombes rebuilt walls and reinforced their edges with concrete blocks. Where rain had washed out the earthen path, he slowed entropy by inserting stainless steel channels to collect and eject rainwater and snow melt. Where the terrain fell too steeply, metal steps negotiated the slope. Where moss and dirt

had obscured the surfaces of several erratic boulders, the artist Carmen Perrin and a team of students scrubbed their surfaces to return them to a pristine state—free from the forces of time that had acted upon them. The Voie Suisse itself was temporary, intended to last only two years, and the coherence of its forms have ultimately surrendered to erosion, sedimentation, and the spread of native vegetation.

It is entropy—here taken as the product of environmental forces and gravity over time—that creates building ruins. In the American Southwest, for example, both native and Spanish builders used adobe to construct their dwellings and churches. As unfired clay, usually formed as bricks, adobe is subject to rapid degradation if not maintained on a regular basis. A coating



Descombes, Georges, Voie Suisse, Lake Brunnen, 1990, Stone path

¹² The primary documentation for this project appears in Raymond Schaffert and Georges Descombes, editors, *Voie Suisse, l'itinéraire genevois: de Morschach à Brunnen*, Geneva: République et Canon de Genève, 1991.

of mud plaster protects the adobe blocks.¹³ Rain and wind will eat into the building fabric, first eroding its parapets, then the mid-sections of its walls. In time the ruins of these Spanish churches acquire a nearly standard form: corners, reinforced by the intersection of two wall planes survive for longer periods than the walls that connect them.¹⁴

Through time, architects have aspired to have their work endure as formidable ruins. Grand works of Roman architecture like the fabric of Pompeii and the Baths of Caracalla are known to us primarily as ruins, as an architecture shaped by the entropic processes that accompany the passage of time. There is a certain grace and a beauty to the ruin that derive from forms invested with multiple histories: personal, social, institutional, and environmental.¹⁵ Today, it is difficult to escape our idea of ruins inherited from the Romantic period because the ruin was so much the subject of that era's painting and poetry. Gazing upon the ruin we reflect upon centuries past, what we have gained and what we have lost. There is a *vanitas* aspect as well. We too shall perish; we too shall become ruins; entropy shall work upon our bodies as it works upon these buildings and landscapes.¹⁶ Especially to those with education the ruin stimulates contemplation

and reflection. But we might also ask how many years and civilizations must pass before the remains of a structure or landscape can be treated poetically as a ruin.

We may actively and positively consider entropic processes in the making of our landscapes, or they may unknowingly take place without negative impact (Of course, they may also help improve the landscape in unforeseen ways).¹⁷ Considering entropy raises the question of maintenance and care. Do we regularly maintain, or do we establish a basic condition and then release control? The Swiss landscape architect Dieter Kienast used rammed earth (*pisé*) to build walls whose erosion marked the passing of seasons and years with forms continually modified by the severe Swiss climate. In the Krummenacher garden in Zurich (1995), for example, the stages of the pours of earth took form as lines that from their origin displayed the history of their making. Over time the edges and profile of the wall have softened, and the aggregates within the mix have acquired increased prominence.¹⁸ Here Kienast used an earthen wall as a planned ruin constructed as much on entropy and erosion as of rammed earth.

Taken broadly, entropy builds up as well as breaks down. While the erosion

¹³ In the American Southwest mud plaster must be renewed every two years in order to avoid the degradation of the adobe bricks beneath the coating. See Bainbridge Bunting, *Of Earth and Timbers Made: new Mexico Architecture*, Albuquerque: University of New Mexico Press, 1974 and Marc Treib, *Sanctuaries of Spanish New Mexico*, Berkeley: University of California Press, 1993, pp. 31–37.

¹⁴ Typical of this pattern are the ruins of the 17th-century church at Pecos, New Mexico, although the church has been partially restored. See Treib, *Sanctuaries of Spanish New Mexico*, pp. 201–217.

¹⁵ See Marc Treib, editor, *Spatial Recall: Memory in Architecture and Landscape*, London: Routledge, 2009.

¹⁶ Erwin Panofsky, "Et in Arcadia Ego: Poussin and the Elegiac Tradition," in *Meaning in the Visual Arts*, Garden City, NY: Doubleday, 1955, pp 295–320.

¹⁷ Coverings of dirt, moss, and vines often cover defects in design and construction. Frank Lloyd Wright once noted that doctors can bury their mistakes, but that architects can only advise their clients to plant vines.

¹⁸ "The humus and slightly clayey earth material is filled into the frame in layers and then stomped down. The wall is then covered with a rusting steel plate to prevent water from draining into it. The layers of soil remain visible in their various shades of brown. the wall shows a 'lively' mutable picture which changes in color and



Kienast Dieter, Krummenacher garden, Zurich, 1995

that devours hillsides and riverbanks is an obvious entropic process, so too is the silting up of harbors and channels. Entropy thus embraces both degradation and deposit, wearing down as well as building up. And should we accept that entropy represents the movement towards homogeneous order, we can propose a corollary to the basic principle: that at times, certain types of growth also represent a type of entropy.

Designers and critics tend to focus on the making of landscape architecture rather than on the effects of time and entropy on the landscape's existence.¹⁹ It is entropy that creates building ruins after the architect has left the scene. But after

the landscape architect has left the scene, it is the landscape and its vegetation that often prevail. Vegetation enters the cracks in the asphalt that result from entropy and human neglect. In accord with environmental and soil conditions the spread of weeds moves toward a uniform order, and vines like kudzu may come to carpet every available surface, both horizontal and vertical. As a historical example we could cite the mosses that now lovingly blanket the surfaces of Saiho-ji—the so-called “moss temple”—that invaded the earthen terrain of this fourteenth-century temple in Kyoto. The intrusion of the moss, we are told, was not planned, but instead accompanied the turn of centuries and the

structure depending on the time of day and year. It has thus become the bearer of the image of the ordinarily hidden earth and contrasts strikingly with the differing greens of the plants and the gravel.” Dieter Kienast, *Kienast Gärten Gardens*, Basel: Birkhäuser, 1997, p. 161.

¹⁹ The exception may be the critic's complaint of poor craft or maintenance.



Saiho-ji, Kyoto, 1338, Muso Kokoshi, Classic view

intrusion of vegetation.²⁰ Following the precepts of Zen Buddhism, those who tended the garden accepted, as natural and beautiful, the distribution of moss across the land and upon the trees. In almost diametrical opposition, the French formal gardens of the seventeenth century fought the forces

of entropy that accompany time, waging a constant battle between aesthetic aspiration and the effects of growth and decay.²¹

The economy often works in tandem with entropy, today leaving us with colossal industrial ruins that have formed the bases for such notable landscapes as Gas Works



Park in Seattle, Washington (Richard Haag, 1971–1988) and Landschaftspark Duisburg-Nord (Latz+Partner, 1990+).²² Do these constructed wastelands operate as true ruins, or merely as remnants of a prior age whose industry has become superannuated?²³ Over time their ability to retain memories will diminish and new sources of meaning will be extracted from them or deposited upon them. And over time, if left untended, vegetation like the birch tree, will prevail. When left untended in an environment ripe for growth, nature comes to dominate culture: vines cover the structures, their roots prying apart stones, their canopies concealing buildings and even complete civilizations. If we accept that the vine can be an agent of entropy—like the moss at Saiho-ji—vegetation becomes one of entropy’s most powerful forces.

Corollary

Late in the twentieth century, certain landscape architects consciously acknowledged entropic processes in their designs, perhaps drawing upon those ideas advanced by Robert Smithson decades earlier. Hargreaves and Associates, for example, emulate hydraulic flows in shaping the earthen mounds that structure and energize their

²⁰ An appreciation of the effects of time are highly appreciated in Japan, represented in words such as *wabi* and *sabi*, both of which involve notions of patina and the profundity of objects and places imbued with a history acquired through existence. See Makoto Ueda, *Literary and Art Theories in Japan*, Cleveland, Ohio: Western Reserve University, 1967, especially 221–230.

²¹ Treib, “Traces Upon the Land,” pp. 45–49.

²² On Duisburg-Nord, see Udo Weilacher, *Syntax of Landscape: The Landscape Architecture of Peter Latz and Partners*, Basel: Birkhäuser, 2008, pp. 102–133.

²³ See Marc Treib, “Remembering Ruins, Ruins Remembering,” in Treib, *Spatial Recall*, pp. 194–217.



Emscher Park Daisburg view

park designs. Whether these forms perform scientifically or not is open to question, but the designs nevertheless demonstrate an awareness of and interest in the processes of erosion and deposit along riverbanks.²⁴ In the firm's work these earthen forms and open-ended processes have played a vital role in the generation of the designs. Dieter Kienast irrigated walls of tufa stone to encourage the growth of moss and ferns. His design for a small courtyard for Basler Partner in Zurich has flourished in damp sub-grade conditions removed from almost entirely from direct sunlight. At the Bloedel Reserve in western Washington State, the governing design strategy has been a give and take between growth and submission. Restraint, for example, controls the forms of a collecting pond and the hedge that




Bloedel Moss Garden

²⁴ John Beardsley, "Entropy and the New Landscapes" in Hiroki Hasegawa, editor, *Hargreaves: Landscape Works, Process Architecture* 128, 1996, pp. 14-25.

surrounds it. But perhaps recalling the garden of Saiho-ji, the landscape architect Rich Haag let moss drape the surface of the ground and the stumps of trees that remained from a forest harvested long before the landscape architect entered the picture.²⁵ As in Kyoto, the moss thrives under the region's humid conditions. The play between the moss covering and the tree remnants has fostered a quiet beauty,

ever-changing, as the tide of moss advances and retreats at different times of year.

Entropy and the forces of nature erode our initial efforts at making—whether they are landscape or architectural—leaving what remains to use in a new way, or for us to consider in a new way. In time, we may come to understand that nature is dynamic, with neither climax nor steady. 

²⁵ On the Bloedel Reserve see Lawrence Kreisman, *The Bloedel Reserve: Gardens in the Forest*, Seattle: The Arbor Fund, 1988, and William Saunders, editor, *Richard Haag: Bloedel Reserve and Gas Works Park*, New York: Princeton Architectural Press, 1998.