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RICE UNIVERSITY

The Garden in the Machine:
Rethinking Nature and History in the Post-Industrial Landscape

by

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Lying in the wake of accelerated technological advancement is a landscape of economic and environmental consequence. As older industrial facilities become obsolete, newer technologies look towards virgin land for growth. In turn, the industrial city, once the recipient of generous corporate taxation and stable work force, is saddled with social unrest, economic stagnation, and vast tracts of infrastructure-laden land. Such is the case with the vacated Bethlehem Steel plant in Bethlehem, Pennsylvania.

At the root of this thesis is a conviction that regeneration of this site needs to be approached as a multidimensional phenomenon which touches upon the organic, the economic, and the chemical. As such, a kind of petri dish can emerge where physical entropy and the erosion of memory coexist with economic and ecologic growth. This thesis attempts to define a new beginning by bridging the cleft between growth and decay. The history of this site, its entropic future, and the beginnings of a new history are conflated into a single continuum.
I would like to thank the following friends for their support in times of desperation:

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Lehigh Valley, a mineral rich region straddling the Lehigh River in eastern Pennsylvania, was once the beneficiary of staggering industrial prosperity. Heavy deposits of limestone and anthracite coal line the area's geology thus triggering the growth of iron, steel, and cement industries. On the eve of millennial eclipse, as technological shifts associated with heavy industry, places like the Lehigh Valley must bear witnesses to this shifting and assess their terminal landscapes.

Driving east on route 412 through the city of Bethlehem you can only sense traces of ruination. Bands of narrow rowhouses line the streets hinting at past lives and communal experience. Thin layers of pollutants and refuse throw the city into the grayest of blue-collar America. Inside the neighborhood diners, men ponder over coffee mugs and smocks, garments soiled though years of manual labor. Driving further with the flow of the Lehigh river, something begins to take form. Disparate rail lines course through the city fabric and begin to converge upon the river bank, channelized and devegetated. A 200-year street grid, dense with infantile plant growth parallels the rail tracks indicating infrastructure removed and is met by a mass of enormous industrial buildings whose leading edge is the river bank. The rail lines begin to converge into two cords, bifurcating the terrain. The streets become more dense, compressed, and striated.
between road and river. A knot of pipes and stacks rise above the mass. Soon a kind of impenetrable landscape emerges, a continuous surface of facets, corrugation, and brick. A rift in the surface reveals a labyrinth of infrastructure, rusting and dormant, strewn with debris. The presence of the river is soon lost as the site thickens to an unknown dimension. A massive hollow in the earth indicates the vacated storage bins. Moving into the landscape, all sense of direction is lost. The consistency of the ground is unfamiliar, black and grainy, rising gently towards the East. Mounds, buildings, debris, and infrastructure permeate the earth. The terrain is vast, proportionless...geologic. The sense of ruination is now complete.

Such was my first impression of this landscape. The image was fixed in my mind: a fountainhead of endless curiosities and concerns. Subsequently, the more I uncovered, the more complex the scenario came to be: corporate histories, geologic drifts, industrial demise, ecological remediation, labor struggles, urbanism, iconography, capital investment, real estate, etc... At the root of this investigation has always been a conviction, despite all vectors pointing towards exhaustion and termination, that this scenario was latent with unformed potential. It became clear to me that the thesis was not about specificities but more about creating a generalized framework through which to visualize this potential.
Collapse
A photograph by Walker Evans taken in 1930 reveals the sublime yet tragic relationship between industry and society. The image is banded with the cemetery in the foreground, rowhouses in the midground, and the factory in the background. Here, the distinction between work, life, and death are flattened into a single, if not beautiful continuum. The photograph was taken when Bethlehem Steel was a formidable engine of American industry, producing nearly 10 million tons of steel annually and employing over 60,000. By today's standards, working conditions within the plant were horrific in 1930. Immigrant workers, reluctant to unionize, worked for substandard wages in dangerous and caustic environments. The laborers were subject to the tenants of Scientific Management as outlined by Fredrick Taylor a few decades prior in that very plant. The corporate strata was becoming headstrong and increasingly hermetic, reaping unprecedented profits from wartime demands and infrastructural expansion. This photograph was taken at a pivotal period between corporate brilliance and ingenuity on the one hand, and corporate myopia coupled with worker featherbedding on the other. These shortcomings proved to be terminal and intractable resulting in the ultimate demise of the industry and the rise of the kind of landscape described above.

Bethlehem Steel traces its history to a modest iron producing facility along the banks of the Lehigh
River. Close proximity to ore and limestone reserves along the Monongahela river was an important factor in rail production for cross-continental transport. The Bessemer process for producing steel was implemented in 1873. This process, by introducing air into the molten metal, produced a rigid and tensile chemical composition. The vast geographical distribution of the twelve plants was of vital importance. The structural properties of steel were subsequently useful in military purposes. After leaving US Steel (the highest volume steel producer) in 1903, W. B. W. Schwarzbach joined Bethlehem Steel, incorporating the company and globalizing its holdings. The most significant corporate decision occurred in 1908 when Schwab introduced the first rolling mill in the United States. The mill produced the first wide flange structural shapes in the US which revolutionized the scale and capacity of the building industry, further securing the company's viability. By the onset of World War I, Bethlehem Steel's annual steelmaking capacity exceeded 1 million tons and the corporation employed over 15,000 workers. The plant produced vast amounts of ships, armor, guns, and munitions for the United States and Allied forces. The interwar period witnessed unprecedented growth with numerous mining and manufacturing acquisitions. Significant achievements include manufacture of U.S.S. Lexington, the first US airplane carrier (1925), and fabrication of the Golden Gate Bridge, George Washington Bridge, Rockefeller Plaza, and the US Supreme Court.
In 1941, nine years after Evans photographed the plant, the United States entered World War II. The war effort propelled Bethlehem Steel into a production frenzy, building over 1000 ships and employing nearly 300,000 workers. This monumental effort will forever grace the legacy of Bethlehem Steel. In terms of corporate vitality, perhaps a more telling event also occurred in 1941. The certification of the United Steelworkers of America became the crowning achievement of exploited laborers who won a hard fought victory culminating in a violent four day strike in Bethlehem. Although serendipitous given the aforementioned wartime demands, this unionization became a formidable counterthrust to postwar productivity contributing to the ultimate demise of the industry. Eugene Grace, an executive with the plant since 1899, became chairman in 1945, replacing the visionary Schwab. During Grace's position as chairman until 1960, Bethlehem Steel recorded staggering production growth. Annual steel capacity rose to over 23 million tons by the time Grace retired. Accordingly, Grace was repeatedly endowed with the highest corporate salary in the country. This overabundance of wealth bred the kind of corporate hermeticism and extravagance barely imaginable. The corporation, without the leadership of an executive to recognize increased internal stagnation.
Exploiting the apparent strength and wealth of the postwar corporation, union officials began demanding more liberal contract conditions. Bethlehem Steel habitually acquiesced to these demands as well as petty labor grievances which resulted in steady increases in labor costs. It became widely known the steel workers were paid twice as much as any other industrial worker. That figure was compounded with contractual arrangements which literally forbade technological advances which might jeopardize existing jobs. A job in the steel industry became highly coveted and the unionized workers understandably guarded their turf. The implications of these conditions became increasingly manifest. The steel industry had a veritable monopoly on steel production. War-torn countries abroad still rebuilding their respective industries did not pose a serious market threat. Hence, as labor costs increased, the industry obliged itself to match the increase in terms of product costs. By the time Japan became a chief competitor in the 1980's, steel produced in the United States was twice as expensive as steel imported from Japan.

The opening of the Burns Harbor plant in Indiana in 1962 was the primary postwar investment which allowed the corporation to remain financially solvent. Utilizing more advanced and efficient
federal import quotas, the industry was in a tailspin and even the most drastic of measures did not seem to reverse the trend. To further the frustration, stringent environmental standards were levied against the industry siphoning money into nonproductive recalibration. A final blow was the rise of the minimill. The minimill, exploiting the surplus of global steel, relied entirely on recycling technology, thus circumventing the need for costly mining and shipping operations. As all of these forces began to converge, it became inevitable that Bethlehem’s flagship plant would have no choice but to cease operations. Thus, starting in October of 1995 the long process of plant closure began with the shutdown of the historic Grey Mill, renowned for its massive beam rolling capabilities. In March of 1998 the final closure will be complete with the shutdown of the coke plant, releasing the remaining 300 employees.

The collapse of this engine is cityfelt. Eighty percent of Bethlehem’s work force have lost their jobs in the last two decades. The statistically low unemployment rate belies the true condition of the city. Former union workers now rely on either forced retirement pension funds or belittling local service jobs. Businesses whose viability was based almost entirely on the massive localized labor force now face imminent closure. Once the recipient of healthy corporate taxation, the city is now ques-
tioning its own financial solvency. It has begun to degenerate both physiologically and psychologically. Buildings remain unkempt, debris has begun to accumulate, and local charities and organizations have disbanded and given way to crime and alcoholism. The American steel industry has nearly exhausted itself. The forces which have impacted its demise are complex and varied but have become clear in retrospect. The corporate history of Bethlehem Steel offers a case study painfully laden with the universal problems of the industry which have led to its present anemic state. Despite attempts at modernization, the industry continues to stagnate as importation increases the plastics industry makes substantial inroads into markets traditionally dominated by steel. In sum, the closure of the Grey mill can be seen as a seminal event marking industrial collapse and imminent technological change at the close of the millennium.
As the world witnesses the shift from heavy industry to digital and telecommunications technology, concern has begun to mount about the fate of those regions left in the wake. It has been documented that over 130,000 abandoned or undeveloped industrial sites grace the American landscape. Given its bounty of natural resources and geographic location, the state of Pennsylvania harbors a rich history of industrialization and can thus lay claim to many of such sites. The brownfield is a product of the 20th century. It is landscape of transient capital. Industry never claimed to be a fixed entity. As productivity and profitability diminishes, industry faces less resistance. Land is a commodity for industry, to be discarded.

In Pennsylvania, a concerted effort, spearheaded by Governor Ed Rendell, has been made to revitalize these postindustrial landscapes, or the Brownfields. Most Brownfields are shouldered by local municipalities who are forced to offer tax and other incentives to help redirect business and industry back into the city. Only recently has the onus been placed on vacating industries to responsibly remediate contaminated land. Federal funding is provided only to the most contaminated areas designated as Superfund sites. A great paradox resides in Brownfield reclamation initiatives. Despite ethical concerns, it is simply not economical to redevelop these sites relative to the cost
and accessibility of underdeveloped Greenfields. Brownfields are typically contaminated and laden with derelict infrastructure and outdated facilities. Remediation and demolition are timely processes fraught with legalities and bureaucratic snags.

Such is the case in Factory Hill. Fifty percent of the land owned by the plant is the most contaminated on the grounds, standing in the center of nearly a quarter-mile diameter of oil-contaminated by benzine and PCB's. The pipe and ductwork used for transport and insulation throughout the blast furnaces are heavily laden with asbestos.

This is an industrial landscape: a production in the century industry. The banks of the Lehigh River, once the home of industrial deposits and natural vegetation was slowly cleared and excavated. Slag, the principal by-product of the steel and iron making process, became the "new earth" dispersed evenly across the site creating a new datum for industrial production. Slight undulations and swells in the land below the plant are in fact accumulations of slag on which new buildings were constructed. To the east, slag deposits have accumulated to depths exceeding 50 feet creating a topography proportional in scale and shape to the surrounding hills. Sunken within this landscape
In this context, however, Smithson's landscape takes on an unsettling sublime beauty. This beauty is conditioned by several factors. First, the landscape becomes eligible in nontraditional terms, reducing a man's conditions of figure ground to matter alone. Land, building, deors, and geology become integrally inseparable. A Cartesian steel-framed building is eligible as concentrations of the material and idea. The land on which the building rests is made from the same constituents in different concentrations. Secondly, the site is secondary, of history and memory.
Debris and by-product are mineral counterparts to historically significant products at large. It is conceivable that a handful of slag could be the dross produced by the manufacture of a steel cable of the Golden Gate Bridge. That same handful may contain the liquefied remains of the man once fallen into a vat of molten steel. A scrap of rusting steel may have been hewed off a beam now lodged within a Chicago landmark. The truly terminal quality of the landscape is most strongly evidenced by silence. This silencing of industry creates a cast of imminence. This sense of imminence leads to perhaps its truest and most fundamental beauty: the potential of a new beginning. The skies, once choked gray with effluents are now blue and crystalline. Shoots of curious vegetation have begun to take root in the matter. Long-standing water-puddles have begun to cultivate algal growth. Rabbits and deer can be seen occasionally scampering across the terrain. Clear water runs past the derelict spigots extending into the river. A machine in the distance lifts mounds of slag to be recycled for road construction. Discarded steel machinery and scrap are cloistered and removed to be remelted and recast as new componentry. Microscopic organisms filter contaminants from the soil. Indeed, these processes had begun even before the plant closure. Barely perceptible, a rebirth of great magnitude has taken root.
In his book *Between Landscape Architecture and Land Art* Weilacher discusses the emergence of a new landscape sensibility which acknowledges the "...disturbed relationship of man to nature and the ensuing worldwide threat to the ecological balance. (Weilacher, 9)." The canonical land art projects of Smithson, Heizer, Christo, and others convey a rather different sensibility. Most of these projects concerned themselves more with inscriptions and forms placed on or within the landscape. Smithson's embrace of monumental and abused terrain had a strong conceptual grounding which was biased more towards the critique of Post-War artistic practices than the natural processes of regeneration or reclamation. Spiral Jetty, although exploiting organic processes such as crystalline growth patterns, was a project principally about implantation of a foreign figure in a remote landscape. Even his projects sited within abused landscapes such as *Broken Circle* and *Spiral Hill* do not attempt to move beyond iconographics. The impact of Heizer's *Double Negative* is engendered by optics and magnitude. The incision in the landscape is arguably self-referential. Indeed, although interest began to mount amongst Earth Artists, the notion of Land Reclamation had not yet been institutionalized. Smithson initiated the idea of reclamation but did not live to see the progress in the forthcoming years. A year after Smithson's death in 1972, the notion of Land Reclamation was given legitimacy by the US Senate who defined it as follows:
Reclamation means the process of restoring a mined area affected by a mining operation to its original or other similarly appropriate condition considering past and possible future uses of the area and the surrounding topography and taking into account environmental, economic, and social conditions... (Tiberghien, 116)

Despite conflicting ethical and artistic opinions regarding the merit and necessity of such projects, several reclamation projects had begun to take form: Robert Morris Untitled (Earthwork to Reclaim Gravel Pit, King County) (1979), Nancy Holt Sky Mound (1985), and Michael Heizer Effigy Tumuli (1988) to name a few. These projects cleaved a path which would ultimately define the most ecologically intelligent landscape projects of the past decade.

Three recent projects are particularly interesting within the framework of Land Reclamation/Regeneration. The most subtle perhaps is Mei Chin's Revival Field (1991-) sited outside St. Paul, Minnesota on Pig's Eye Landfill. This State Superfund site was the destination of all waste accumulated from the Twin Cities since 1972 and now contains dangerous concentrations of cadmium. Chin has begun a testing site here for the economic and ecologic viability of "hyperaccumulators": plant life
which absorbs heavy metals in the soil. The plants are periodically harvested, and incinerated. The metals are then extracted and sold. This project moves well beyond the confines of art and landscape architecture by introducing issues of economics and ecologic decontamination.

The Rocky Mountain Arsenal is a place which confuses binary conditions of the natural and the man-made. Established in 1942, this site has been used for the manufacture of chemical weapons until the late 1980's. It encompasses nearly twenty-seven square miles of prairie only ten miles north of Denver, Colorado. Because of the massive doses of toxins present throughout the site, it was designated as a National Priority Superfund site in 1987. Curiously enough, the site has become a substantial refuge for wildlife which benefits from the dearth of human activity. In 1992, Congress passed legislation designating the arsenal as a National Wildlife Refuge upon completion of the environmental cleanup.

Located within Germany's Ruhr District is a project which has served as a form of template for this thesis. This site is similar in scope and condition to Bethlehem, encompassing over 200 hectares of industrial terrain. The facility output 35 million tons of pig iron between 1900-1985. Since its aban-
ddnment, the buildings and ground have become fertile soil for a strange and rare variety of vegetation. This flora functions similarly to the hyperaccumulators of Revival Field. German landscape architect Peter Latz was commissioned in 1990 to develop a controversial proposal for “the park of the 21st century” coined Landschaftspark Duisburg-Nord. The most provocative aspect of this park is the subtlety of intervention. The ruinous condition of the infrastructure has been left intact, and the growth of rare plant and moss colonies have been cultivated. Even the most toxic extremities of the site are supporting flora and fauna.

Latz’s response to these mutant ecologies is not to normalize their condition but to recognize and cultivate them. Subtle management of the vast areas of mining spoil and ore dumps strategically supports or inhibits the natural colonization and succession of flora: dense wilderness is allowed to develop or growth continually stripped back to sustain an artificially naked pioneer: slate to the black land, the preserve of the mosses. In other parts of the site: Latz re-works this recognition of these special states within newly established gardens and artificial fields of crushed minerals that mimic the dry, acid conditions of adjacent mining dumps, designed to sustain their own successions of mosses and fine grasses. (Beard, 32)

These projects call into question the distinction between the natural and the man-made. Contemporary views of the state of nature is still influenced by idealized notions of untouched natural beauty.
The property that Bethlehem Steel had secured a century ago is surrounded by an entirely different context today. The small towns of Allentown and Bethlehem have grown and merged into a single metropolitan entity. The efficacy of rail transport has been superseded by the Interstate Freeway system. A once small regional airport has become an international transportation hub. Lehigh University has expanded and become one of the country's premier institutes for the study of technology. With this expansion, urban land has been secured for a network of local parks. Indeed, the entire Lehigh Valley has become a node of exceptional regional growth. Given its context, size, and geographic location, this site benefits from nearly all the necessities required for what Manuel Castelles has coined the Technopolis.

The principle obstacle preventing a new state of productivity approaching that of a technopole are precisely those physical qualities discussed above. As was noted, the intractable nature of the buildings and infrastructure make demolition cost ineffective. Furthermore, the buildings are historically significant for both their structural integrity and also for the technological and labor advances made within them. Moreover, the iconographic power of the buildings is a means by which the
people of Bethlehem have measured their existence. Rossi clearly articulates the meaning and significance of monuments in the city as mutable yet intractable. The Walker Evans image conveys a continuum in which life, work, and death hinge upon each other. This continuum is grounded by the physical presence of the plant. In sum, the significance of these buildings extends beyond their own private history and even beyond their relationship to the city; they in fact are the city. The fate of this site is uncertain. The myopia of real estate speculation has yielded only the worst extremes of redevelopment. One extreme, in alliance with the tourism industry, proposes to commodify and thematize the history of the site. In this case, its true history and physical attributes are anesthetized or eradicated altogether. The other extreme, as evidenced by the generic indus-
trial building constructed on a fragment of the former grounds of the plant, is complete erasure. This proposition denies the complexities and potentials of urban renewal and opts instead for well tested suburban greenfield planning strategies. The problem with both of these strategies is that they deny the potential for regeneration.

At the root of this thesis is a conviction that reclamation of this site need not be so narrowly defined. I am proposing a multidimensional regeneration process which touches upon the organic, the chemical, and the economic. As natural processes of entropy continue, ecologic and economic remediation accelerate. The plant, as a potent signifier of the continuum of industrial life, will begin to erode with passing on of generations. The site becomes a veritable petri dish where physical entropy and the erosion of memory coexist with capital and organic growth. This thesis attempts to define a new beginning by bridging the cleft between growth and decay. The history of this site, its entropic future, and the beginnings of a new history are conflated into a single continuum.
Fig 2. The primary structuring device for the park is a field of “ecological sinks.” These plots, 200’ x 75’ each, function as an alternative to mass demolition. The reading of the site as a contiguous mineral landscape, thus flattening hierarchies of building, infrastructure, and debris, has justified the distribution of these sinks in a non-hierarchical array. The sinks penetrate the infrastructural thickets, allowing for permeation of sunlight and ventilation and introducing a pointal field of biomass. The biomass would aid in the environmental remediation process, allowing natural extraction of contaminants. Eventually, normalized ecologies would take root, migrating over time and interconnecting to form an ecological network.

Decontamination of the land would curb speculative investment away from suburban greenfield paradigms and back into the city. The voluminous spaces of the existing sheds would eventually accommodate a new landscape of multiple use fed by lines of new infrastructure. The visceral qualities of the site, its debris, machinery, and slow deterioration, would comprise the “industrial preserve,” offering a poignant counterpoint to processes of regeneration.
Insertion of the ecological sinks induces a violent collision of industry and ecology. Zones designated to receive the biomass are modified to promote ecological growth. Brick infill located within building frames is removed, crushed, and spread along park paths and parking areas. Roof cladding is removed and either melted or crushed and reformed into building materials. Newly exposed structure is sandblasted and painted white. Denuded roof areas are reclad in glass panels formed from casting pit sand. The open framework and glass roof opens the space inside the building to sunlight and ventilation. Soil containing heavy metals is either removed or remediated. Metallic content is extracted and sold. Infrastructure and debris is removed, melted, and reformed. Slag is removed and used as roadway underbedding. Layered upon the sink are systems of pathways and irrigation troughs which distribute water from the river and building roofs to the sinks.
The site is laden with miles of subgrade liquids infrastructure. Millions of gallons of water were once pumped from the adjacent river to aid in the cooling of molten steel. Removal of these derelict pipes and spigots allows for a network of new “leaky” irrigation troughs. The troughs utilize existing pumping facilities to siphon water from the river and allow it to circulate through the site. Conduits are cast within the trough walls to permit water to leach into the adjacent soil. This porosity acts both as a cleansing mechanism, filtering topsoil contaminants, and a growth accelerator, encouraging aquatic and plant life. Disposal of the clay tile and steel infrastructure becomes a lucrative venture. It is crushed or melted and then sold to various building markets.
Mutations of naturally occurring ecologies have been reported in contaminated areas. This occurrence confounds romantic ideals of nature as an autonomous phenomenon external to human interventions of mankind. The “Bio-Remedial Park” is structured by landscapes characterized by the levels of contamination existing in their soils. These ecologies, although of different varieties, will eventually give way to indigenous flora and fauna as the land is purified.
The magnitude of linear infrastructure required for the production of steel often falls the onus of reclamation efforts. Reuse of these systems can create a hierarchy of new circulation patterns. Old lines of drainage and sanitation can be dismantled and replaced by new systems of purification. Rail lines, filled with crushed debris or slag provide threads of circulation routes.
Movement patterns in steel plants are engineered for maximum efficiency of material transport. The complexity of rail/building interface supercedes automotive circulation requirements. At Bethlehem, roads closely parallel primary rail cords and building striations, occasionally cutting across the grain thus creating mutated version of the city gridiron. Minor extensions and joints are proposed to provide a more fluid circulation pattern. A direct unmediated extension of the adjacent street pattern would be illogical and an affront to the circulation complexities inherent in the site.
Natural processes of entropy and deterioration are curbed and regulated in contemporary building practice. Conversely, the post-industrial landscape is colored by chemical degradation and dereliction. Rusting steel, oversized machinery, and discarded componentry are inherent attributes of this terrain. The impetus of the "Industrial Preserve" is to allow these processes to continue in tandem with processes of ecological and economic regeneration.
Proposed

Existing

Capital investment in Brownfields is typically bound by conservative perspectives which cannot see the potentials of redevelopment. The long, high, striated volumes of the shed buildings at Bethlehem offer a potential for a veritable landscape of speculative real estate investment. Lines of new infrastructure equip the interventions while leaving derelict pipes and water lines to be removed and recycled.
Regeneration Diagram

2035