Chapter Title: Second Nature: On the Social Bond of Ecology and Architecture
Chapter Author(s): Richard Ingersoll

Book Title: Reconstructing Architecture
Book Subtitle: Critical Discourses and Social Practices
Book Editor(s): Thomas A. Dutton, Lian Hurst Mann
Published by: University of Minnesota Press  (1996)
Stable URL: http://www.jstor.org/stable/10.5749/j.cttttmg1.7

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at http://www.jstor.org/page/info/about/policies/terms.jsp
JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

Antiecology

Ecology and architecture make strange, but star-crossed, bedfellows. The former is the study of how all things in the natural world are related to each other, while the latter is in its essentials the reaction of the human imagination to nature's inhospitality to dwelling. By extension, the production of buildings, cities, and regional infrastructures has directly and indirectly provided the impetus for technological and industrial transformations that have thoroughly transformed the natural world. Because the impact of human interventions during the last two centuries has been so pervasive, it is difficult to claim that such a thing as "nature" still exists.  

The appeal to ecology within the discourse of architecture arouses a historic paradox, since every act of building is inherently antiecological to the degree it induces a displacement of "natural" relationships. At its most confident, architecture is portrayed as a second nature. As Louis I. Kahn so succinctly put it, "Architecture is what nature cannot make." Among the various intellectual tactics that attempt to mitigate architecture's antiecological position are the symbolic representation of nature in architecture, the use of built form to imitate or enhance natural features, or the recourse to theories of nature as analogues in design methods. Leaky roofs, cracking foundations, spalling surfaces, infestations of insects, mold formations, fires, floods, earthquakes, and the like are nature's rebuttal to any architectural position.  

Since the social movements of the 1960s, ecology has become an ineluctable political issue and has been admitted as an awkward guest in architectural theory. The alarm over industrial pollution, the disgust with consumer culture's wastefulness, and the overall recognition that human technology has accelerated entropy to the point of endangering the survival of the species are part of the social concerns that have inspired a mandate for "ecological architecture." Entropy, also known as the second law of thermodynamics, a theory according to which all matter and energy, once expended, are dissipated, has become the basis of a collective sense of guilt. Although entropy is theoretically irreversible, there are various conservationist strategies for agriculture, industry, and urbanism — the three major human sources of environmental depletion — to lower entropy and encourage a "sustainable" environment. The attempt to curtail accelerated entropy is both an ethical and a technological matter. Ethically the ecological position argues for
the rights of nature against the onslaught of development; technologically, the waste and inefficiency of high-entropy design is faulted as a misappropriation of resources. It is in this frequently contentious betrothal, between moral imperatives and the desire for material well-being, that the most important critical positions on ecology and architecture emerge.

Like other aspects of building that require pragmatic solutions, the question of sustainability in architecture is usually breached through technical rather than historical or social criteria. Yet like any other strain of theoretical reasoning, it is caught in a skein of precedents, some to be explicated from written documents, others from built fabric. That passive solar principles, for example, were intuitively practiced since the time of the most ancient cultures until the advent of artificial climate control, yet were not formulated into a conspicuous body of written testimony, is an obvious instance where a theory of ecological architecture must be interpolated retroactively from the measurable built remains. In many preindustrial cultures natural forces were (and still are) commonly treated in a mythopoeic, animistic way. Theories of building from around the world, including those described in the Chinese manual, the Chou-li, dating from the first century B.C., or the similarly ancient Sanskrit treatise, the Manasara, as well as the principles discernible in the practice of the ancient Greeks, call for the planning of buildings as a sacred act that will be respectful of these forces. The survival of Feng shui in parts of China and the ritual placement of a growing tree on the top of a new building during its construction in northern European countries are evocative reminders of this traditional reverence for the transcending power of nature. Industrialism and the more competitive aspects of capitalist production have tended to deny architecture its sacred and metaphoric value, which has been an instrumental phase in the transition to high-entropy building practices.

Previous to the widespread reproduction of Isaac Watt's steam engine in the late eighteenth century, societies generally built in a much more sustainable manner, and the per capita consumption of energy was minuscule compared with that of modernized populations. Currently the combined impact of buildings and urban organization in industrialized societies plays the major role in the budgeting of resources. This aspect of development, which seems at once uncontrollable and yet is the essence of modern policymaking, infuses the question of ecology with social and political imperatives.

Disenchantment with the environmental profligacy of the industrial present has led one strain of ecologically inclined architects to a willfully naive idealization of the low-entropy past. The presumed autarky of the preindustrial village has been optimistically rehabilitated as a mythical alternative to the irresponsible waste of the metropolis. Included in this contingent would be architectural theorists such as Christopher Alexander and Leon Krier, who, while quite different in their approaches—the former advocating a neovernacular architecture, the latter a neo-
classical—both embrace a systematic noncooperation with the forces of modernity.7 Nostalgic incantations of this sort, as much as they may pamper a collective guilty conscience about development, always involve a selective and mystifying use of the past that precludes the dynamic social processes of history, which are inextricably engaged with those of nature. The static historic model set in the fluid multidimensional reality of time severely limits it as a sufficient basis for dealing with the complex problems of the present.

While many important lessons can be gathered from the past on how to build and how to conserve resources, it should not be forgotten that preindustrial societies, despite their lower entropy, have been responsible for cycles of ecological calamities, such as the salinization during the first millennium B.C. of the Tigris and Euphrates Delta due to overintensive settlement and agriculture,8 the deforestation of the Dalmatian coast to furnish the piles for Venetian palaces, and the recurrence of bubonic plague and cholera facilitated by crowding and inefficient waste management in most European cities until the nineteenth century. A return to the preindustrial past might aspire to redeem the future from high entropy, but it is doubtful that such a move would be made without bringing the baggage of the scientific and industrial revolutions. The infrastructure needed for the latter necessarily relegates the nostalgic models to an epidermal or aesthetic solution.

Probably the greatest factor inhibiting ecology from becoming more than a marginal element of architectural discourse is the endemic utopianism attached to it. Utopian solutions, as first criticized by Marx and Engels, are counterproductive to real social progress because they evade the political process it would necessitate to achieve social goals. The sociological naiveté of most utopian models invariably implies some sort of totalitarian subtext about how to achieve and maintain the new system, and this new system is less likely to permit change than the one it proposes to replace. In the case of ecological utopias, the matter of how to effect a transition to sustainability within the constraints of late-twentieth-century capitalism without betraying citizens’ rights is immensely complex.

Ecology movements have secured legislative victories and influenced changes in lifestyles. In practice, however, local advances in environmental regulation are often made to the detriment of environmental quality elsewhere because of the flexibility and dissimulating tactics available to multinational corporations. The banning of a substance like DDT, or more recently chlorofluorocarbons, in one society, with the subsequent unloading of the substance in an unmonitored country, has been standard procedure. E. F. Schumacher’s well-intended slogan for environmentalism to “act local, think global” has in a nefarious way been co-opted during the last two decades by the forces of development in its process of “globalization.”9

A project for sustainability thus requires global strategies that can keep pace with the globalization of capital. But considering the demise of planned economies during the 1980s, which have been mostly abandoned to the unpredictable conse-
quences of deregularization, it is small wonder that ecologists are prone to utopian solutions. Architecture in the name of ecology has attracted more than its share of utopians. If the neovillages proposed by the aforementioned Alexander and Krier can be offered as examples of nostalgic utopianism, there are at least two other strains of utopian efforts that avoid historical precedents in favor of a functionalist model. In one case building technology is limited to the lowest expenditure of resources possible—for example, in works such as Michael Reynolds’s “Earthships” (mud-covered houses that use old tires and cans as primary building materials) or in the fantastic, labor-intensive concrete shell constructions of Paolo Soleri at Arcosanti. This trend, which involves a righteous retreat from industrial and metropolitan civilization to sparsely settled desert environs, belongs to the world-weary tradition of monasticism. The constraints on the conventions of social life and the possibilities of construction only in remote desert areas, however, make such environmentally attractive solutions unfeasible under other conditions.

The other functionalist approach is the pursuit of maximum efficiency through the highest use of available resources, a path predicated by R. Buckminster Fuller and practiced by, among others, Sir Norman Foster. This leads to the project of a technocratic utopia. Fuller was responsible for one of the most unifying metaphors of the ecology movement, “Spaceship Earth,” for which the technocratic implications are obvious. His theory is lodged in the belief that it is not technology that is at fault, but the incumbent inefficiencies of up to 95 percent wasted energy that need to be resolved. The industrial and managerial organization necessary for Fuller’s models, however, implies a world where technological means would probably become more important than social ends.

The utopian solutions for the reduction of entropy, from nostalgic retreats to high-tech assertions, have led to many spectacular architectural hybrids, such as the mud-covered earthships or Fuller’s dymaxion house, a lightweight prototype for mass production, but thus far they have only related to the rest of the built environment as intriguing exceptions. Utopian responses to the environmental crisis such as these, in which a new kind of architectural technique is offered as the solution to problems of great social and political complexity, subscribe to a form of architectural determinism, the belief that architecture controls social relations or behavior. They remain economically unrealistic on a large scale because they are conceived outside of the general economic systems of production and cannot be integrated easily without rupturing the system, nor do they account for a strategy of systematic transformation.

While populist attempts to assuage the antiecological condition of architecture usually rely on a preindustrial ethos that precludes the social and cultural complexities of metropolitan life, high-tech alternatives require the intercession of a technological elite that will bypass the decision-making process of the polis. Both extremes, while they offer attractive models, are delusional and anathema to the...
ideals of the liberal city. Until the problem of high entropy is inscribed in the social and political language of cities, a task in which utopian architectural thinking can have some influence, it will be difficult to forecast strategies involving architecture that are accountable, responsible, or consistent with the ethic of the public realm. Which is to say that unless an ecology-conscious architecture is rooted in social practices, it will have little chance for making a significant impact on the production of the built environment, because, to paraphrase Fernand Braudel, technology alone is never the cause of social change, it is always implemented by social forces.

**Architecture as a Second Nature**

Although preindustrial architecture generally performed with a greater responsibility to the natural environment, the twentieth-century notion of ecological relationships, let alone references to nature, is conspicuously absent from earlier architectural theory. As Françoise Choay concludes in her study of Renaissance architectural theory, unlike any other early culture it “assigned to the organization of built space an autonomous discursive formation.” Aspects of nature, such as growth, proportionality, symmetry, and patterns of fluidity, were generally recognized as analogues to be emulated rather than systems to conserve or to integrate. Architecture and the city became constituent elements of a socially constructed “second nature” distinct from the world as found.

The theoretical autonomy of architecture can be traced to Vitruvius (circa 25 B.C.), whose treatise, while probably not widely followed in its own day, became the basis of the Western canon that developed since the fifteenth century. Vitruvius was primarily concerned with establishing the rules of architecture, describing building types, and explaining proportional relationships, in particular those of the columns. The propriety of the classicial orders became the theoretical obsession in the Vitruvian revival, which set architecture in an ever greater realm of autonomy. Vitruvius, when he writes of nature, invests it with a mythological respect, associating the initial act of entropy, the discovery of fire, with the origins of architecture. This Promethean scenario that combined building a fire with building a house was reelaborated frequently during the Renaissance and might be considered as architecture’s original sin in terms of ecology. Although the practice of architecture in Hellenistic times was demonstrably attentive to solar orientation, drainage, and use of natural materials, these were negligible issues on a discursive level. Vitruvius offers advice about site and wind conditions for founding cities and mentions divination rituals, such as examining the entrails of animals that have grazed on a site being prepared for a settlement, but the majority of his treatise isolates architecture as an autonomous event involving geometry, typology, stereotomy, and artifice.
Leon Battista Alberti, the greatest fifteenth-century interpreter of Vitruvius, was not much more concerned with natural processes in *De re aedificatoria* (1451). Alberti clarified the Vitruvian principles of architecture and opened up the theory by demonstrating the options that can exist for every design problem. He only slightly addresses what could be considered ecological matters, however, when he writes on the siting of cities, always qualifying his judgments with erudite references to ancient authors and rarely providing direct observations of nature. “And so the foremost authors of antiquity,” he explains, intimating Plato and Aristotle’s models of autarky, “...considered the ideal location for a city to be one that provided for all its requirements from its own territory and would not need to import anything.” In Alberti’s treatise, the autonomy of architecture is heightened by his avoidance of natural metaphors: he compares the city first to a house and vice versa, and later to a ship, confining design to geometric and technical analogues. When he compares a building to the body, a famous trope derived from Vitruvius (Book III, 1), later immortalized in Leonardo’s drawing of the “Vitruvian man,” whose body is inscribed in a circle and a square, he treats it in terms of proportionality. Alberti concludes “that the building appears a single, integral, and well-composed body, rather than a collection of extraneous parts.” Architecture is analogous to nature: as a second nature it remains conceptually distinct as the product of human reason. Alberti’s chief criterion for architecture is essentially an abstraction of nature, found in his theory of concinnitas, concerning appropriate proportions and the fitness of parts to the whole.

Alberti’s theory of concinnitas argued for a type of architectural order that can be understood as “organic,” in that the ordering principles of a single building can be projected onto the expansion of an entire city. But his organic order of building is separate from the organic order of nature. In this vein he writes in reference to the merits of round temples, “Nature delights primarily in the circle, need I mention the earth, the stars, the animals, their nests and so on, all of which she has made circular?” Through this type of analogy, rules for architecture could be extrapolated to validate it as an abstract, second nature. It is characteristic of Alberti, who had complex interests, that in some of his nonarchitectural texts he will allude to an entropy-like problem that is not included in his architectural treatise. In *Theogenius*, for instance, he alludes to the vanity of human enterprise: “While the other animals are content with what is given them, man is always investigating new things to infest his world.”

There were other writers during the Renaissance who seemed more attuned to nature, but they had much less influence than Alberti. The eccentric treatise of Filarete, the architectural notes of Leonardo da Vinci, and the enigmatic novel *Hypnerotomachia Polyfili* all communicate a greater sensitivity to the integration of natural processes in relation to building. Leonardo, in particular, was an astute observer of natural phenomena. In his diaries he conceived of multileveled build-
ings and cities with water rushing through them the way that bodily fluids circulate through living organisms. When considering how to replan plague-ridden Milan in the 1490s, Leonardo arrived at a proleptic scheme of regional scale that was likewise more akin to the organization of organisms than of the traditions of city making. He proposed the decentralization of the city into ten generously distributed satellite towns of five thousand dwellings, each served by an efficient system of canals to drain off sewage and facilitate transportation. Filarete, writing a decade earlier, begins his treatise with an anthropomorphic analogy: “I will show you how a building is exactly like a living man.” His radially planned ideal city of Sforzinda alternated streets with canals for efficient transportation and sewerage, although it lacked the sectional complexity of Leonardo’s schemes. The models of Leonardo and Filarete would have reduced densities and improved hygienic and transportational infrastructures, but they had little direct impact on the planning of European cities or the theoretical consideration of nature in respect to architecture, as neither was published until the twentieth century. The Hypnerotomachia Poliphili, printed in 1500, had a wide diffusion as one of the first novels ever published, and some would claim the first printed architectural illustrations, but the message of the book, which involves a kind of initiation to the natural world, was and remains a mystery. Even Alberti’s treatise, published in printed form in 1485, had only a limited influence on the more formally oriented canon, which developed in the sixteenth century with Serlio, Palladio, and Vignola, of a rational and rhetorically correct organization of inert materials disengaged from the realm of nature.

A different agenda for the city, treating it almost exclusively according to military concerns, emerged during the mid-sixteenth century both because of changes in the structure of the state from self-governing city-states to national monarchies and because of the convulsive innovations in ballistic technology. Francesco de Marchi’s treatise on fortifications is exemplary of a trend that treats the city as a military machine, a hovering and perfectly geometrical figure determined by mechanical responses to lines of fire and the rapid circulation of troops. The competitive demands of the military agenda from this point on encouraged the growing alienation between the natural world and mechanical processes.

Considering the aforementioned tendency toward utopianism of ecologically inclined architects in the twentieth century, it seems appropriate that the first Renaissance treatise to propose a reintegration of urban culture with natural processes should be Thomas More’s Utopia. Published in Latin in 1516, Utopia describes an ideal social organization of a city and its territory. More wrote his fictional dialogue in response to the peasant evictions from the land caused by Henry VIII’s rural policies. In his narrative he attempts to imagine a complete alternative to the misappropriation of agricultural lands and the inhumane conditions of crowded cities. His rational solutions envisioned a new egalitarian order in which certain forms of injustice, contingent on greed, poverty, and ignorance, could not
survive. The way of life imposed on Utopia, however, presents such severe limits on basic personal freedoms that the book has often been read as a satire. The contradictions of the original Utopia establish a perennial flaw that can be recognized in most utopian projects.

In the protocommunistic society of the island of Utopia the problems of the distribution of wealth, division of labor, and the management of growth are solved comprehensively. When the optimal size of a city is reached, that is, six thousand families (from sixty thousand to a hundred thousand people), a new town is founded on the island, and if the island fills up, colonies are to be founded elsewhere, using military force, if necessary. The island of Utopia was imagined to reach a point of homeostasis with fifty-four cities, no city different from another.24 Each town was to be located a minimum of twenty-four miles, or a maximum of a day’s walk, from any other. All the houses in Utopia are identical, all the towns have the same plan, all the people wear the same clothes—the only changes that will occur in Utopian cities are the obligatory change of house every ten years so that residents will not become possessive about their houses as personal property. Utopian society was predicated on the maintenance of agriculture, and each inhabitant was obliged to serve for two years on a farm before taking up a craft occupation in the city. The city dwellers would also be inducted for agricultural chores at various times of the year when extra labor was needed on the farms.25 Each neighborhood of a city was organized on a straight street, twenty feet wide, with fifteen houses on either side and ample backyard gardens. A communal house was placed in the middle, where a matron from one of the thirty households was put in charge of cooking for the whole community once a month. There was no private property or need for money in Utopia, where the welfare of each citizen was universally guaranteed. All religious beliefs were tolerated, but the most prevalent belief was Mythraism, which considered the supreme being to be synonymous with nature.

Despite Utopia’s sensible alternative to the crowded European city and its attempt to eliminate the social inequities bred by religious and aristocratic privilege, and despite its reference to nature as the ultimate source of reason, the rigidity of its planning was unwittingly intolerant of the diversity and mutability of nature. The lack of accommodation to either the natural or social processes of change lent a frightening, dystopian quality to Utopia that was acknowledged by More himself in the many ironies embedded in his text, such as the name of Utopia itself, meaning “nowhere.” The work was no doubt intended as a vehicle of critique (at a time when direct criticism was not possible) rather than as an applicable model.

Alberti’s flexible rules for design and More’s inflexible model for society represent opposing positions in a retroactive debate on how to treat nature: the former alienates nature but allows for adjustments according to circumstance; the latter seeks to preserve a natural balance but does not account for nature’s most essential characteristic, that of change. The two positions survived into the nineteenth cen-
tury with such examples as the rational rules for design proposed by J. N. L. Durand and the formulation of a new communal social order projected by Charles Fourier. Durand’s “graphic method” plots standard dimensions of form on a grid with no reference to the natural world; Fourier, in his proposal of the Phalanstery, puts his sixteen-hundred member phalanx of liberated society into a single, Versailles-like building, where individual freedom can be exercised while collective needs are supplied. Durand justified his expedient solutions in architecture in terms of social responsibility as being formally appropriate and respectful of economy; Fourier proposed an architectural solution to contain his new unit of social justice.

Most environmental historians consider the Western humanist tradition, which had its roots in the researches of Renaissance writers like Alberti and More, as the intellectual source of the calamitous path of modern development. The projected conquest of nature through modern science acquired at this time a Faustian subplot involving the redeeming concern for the welfare of humanity, what Marshall Berman so astutely identifies as “the tragedy of development.” In this line Francis Bacon’s New Atlantis (1624) proposed a world made plentiful through a regime of scientists who would institute ways of asserting greater power over nature and eliminating scarcity. The eventual displacement of religious authority by rationalism during the Enlightenment and the application of science to technology established a new ethical frame in which to pursue the exploitation of nature in the name of social justice. The demand for social progress was usually hinged upon material progress and rarely acknowledged the environmental consequences. One of the major ideological tasks of current environmentalism should be to correct this historic rift and resituate the idea of social justice in a dependency on the preservation of nature.

Nature, from the time of Jean-Jacques Rousseau in the mid-eighteenth century, acquired a metaphysical role as the ultimate measure of what is right in the world. If, as Joseph Rykwert has pointed out, Abbé Laugier’s primitive hut, the “natural” foundation of his architectural theory, was sited on Rousseau’s riverbank (where “natural,” preurban man lived happily), Laugier’s treatment of nature is nonetheless metaphoric. Natural relationships are used to justify preconceived formal relationships: a thicket of trees can be ordained as the typological progenitor of the peripteral Doric temple, but it is by no means presented as part of an ecosystem. Nature in this paragon is used as a reconfirmation of formal models. The symbolic use of nature reached its climax in the eighteenth-century formulation of the picturesque English garden, such as Stowe or Stourhead, where nature was made to look more “natural” in order to create emotional effects.

In retrospect it seems that the chief reason for the absense of a theory that would integrate architecture with natural processes in the West can be attributed to the prevalence of anthropocentrism in the dominant philosophical and scientific trends. Nature was in this way kept conceptually alien and separate from cul-
ture, often in the name of social progress. Architecture as a second nature did not evolve in response to the forces of nature but according to the rational practices of development in a man-centered understanding of the universe.

**Ecology Becomes Immanent**

The terms “entropy” and “ecology” were both coined in the 1860s, one hundred years after the introduction of Watt’s steam engine, and about this time a new sensitivity to nature in architectural theory occurs. The motivations to bring architecture closer to nature derived, on the one hand, from transcendentalist attitudes celebrating the oneness of nature and, on the other, from a moral imperative to find palliatives to the effects of industrialism. The horrific accounts of Manchester in the 1830s and 1840s by Alexis de Tocqueville and Friedrich Engels were indictments both of the extent of environmental degradation and of the inhumane exploitation of the working class. This denunciation of the twin injustices wrought by industrial capitalism established a criterion for a contingency that current environmentalists often prefer to leave obscured: although the crisis of natural conditions can be assessed through scientific means and policies and technologies can be proposed to mitigate its effects, the management of the environment is ultimately a social problem requiring political solutions.

While the interrelatedness of the natural world is a common line of reasoning in most non-Western cosmologies, the reigning positivist mentality of the West could not entertain such a concept until nature had been adequately defined in scientific terms. Although Karl Linnaeus’s great work, *Species Plantarum* (1753), is limited to the taxonomy of the realm of plants, it was determinant of a method for future studies in all areas of natural history. His essay “The Economy of Nature” set the coordinates for the future study of ecology. Johann Wolfgang von Goethe, the great poet, naturalist, and connoisseur of architecture, helped to popularize an idea of organicism and holism at the end of the eighteenth century with dictums such as “In organic life nothing is unconnected with the whole.” He revived the tragedy of Dr. Faustus for his greatest narrative, *Faust*, which revolves around the question of the use of resources and its relationship to human welfare.

Another key contribution to the development of a theory of ecology was *An Essay on the Principle of Population* by Thomas Malthus, perhaps the first work grounded in scientific method in a distinguished line of apocalyptic prognoses of human development. Malthus’s analysis, although not his chiliastic conclusions, served as the source for both Alfred Russell Wallace’s and Charles Darwin’s independently arrived at theories of natural selection.

With the publication of Darwin’s theory of evolution in 1859, the concept of holism in the natural world became canonical. It has not only affected the paradigms of scientific thought in related fields, but has had important repercussions.
on economic and political theories as well, since *The Origin of Species* illustrates the dynamic patterns of natural processes that seem to explain, or in some cases justify, those involving human negotiation. The crucial postulate affecting the social sciences has been whether natural selection occurs more through the agency of "mutual aid" or more through competition for resources in which only the strong survive, the latter leading to what is generally referred to as Social Darwinism.

Elaborating on Darwin's theory of the interrelatedness of species in nature, the German naturalist Ernst Haeckel in 1866 invented for his own analysis of contextual biology the proper name of "ecology." Derived from the Greek word for house, the neologism had important metaphoric implications for architecture: the relationships in the natural world being like the organization of a household and vice versa. This use of an architectural metaphor for a scientific study, however, did not automatically stimulate an ethic of ecology in the discourse of architecture. It is the enduring characteristic of metaphors to keep meanings from ever becoming synonyms. If Haeckel's research ever had a direct influence on design it was in the inspirational capacity of his elaborate drawings of natural morphologies, later used to justify principles of balance and proportionality in architectural form.

Haeckel was fascinated with the compensations among species in the natural world and was one of the first intellectuals to advocate the application of natural principles to the human political realm. He believed that obedience of biological laws would result in an equitable, efficient, and peaceful state. Unfortunately this line of reasoning often has been used by Social Darwinists to support racist theories of political order.

Organicism, as it was coming to be understood by naturalists, had a special appeal to Americans. Henry David Thoreau, in his narrative about life at Walden Pond, popularized a radical awareness of organic relationships and natural correspondences. He offered the construction of his cabin, built with borrowed tools and recycled boards for $28.12, as a polemical alternative to the vain and unnatural inclinations of architecture in the 1850s. The American transcendentalist position was transposed definitively to the realm of architectural theory by Louis Sullivan in his celebrated dictum "Form ever follows function," which consecrated the telelogical conclusions of the natural historians. His skyscrapers of the late nineteenth century are designed according to the logic of efficient structures, while the decorative skin laid over the surfaces carried foliated patterns generated by abstracting the forces of growth in plant life.

The shock of the size, speed, and alienation of the nineteenth-century metropolis encouraged various returns to nature. While London and then Paris were being substantially eviscerated and rebuilt during the mid-nineteenth century with new sanitary and transportation infrastructures, the two most influential writers on architecture, John Ruskin and Eugène-Emmanuel Viollet-le-Duc, pursued parallel interests in premetropolitan social organization, medieval architecture, and ob-
servations of the natural world. A comparison of their drawings illustrates their theoretical differences. Ruskin’s depictions of medieval Venice and of alpine rock formations are emotional and atmospheric, beautifully rendered in chiaroscuro, and almost always unfinished; Viollet-le-Duc’s renditions of the same phenomena are graphic, with clean lines, and reveal the precise structural relationship between the parts.43 Ruskin (his early pseudonym was “Kata Phusin,” Sanskrit for “according to nature”) in the 1850s and 1860s became a leading critic of the industrial metropolis, condemning with equal vigor the immoral use of industrial materials for constructions such as the Crystal Palace and the unsavory environmental conditions of big cities. As a step toward interrupting the alienating and polluting methods of industrial capitalism, Ruskin founded Saint George’s Guild in 1871, a neomedieval arts and crafts organization that inspired William Morris, C. R. Ashbee, William Lethaby, and others to create similar guilds.44 Out of this intellectual milieu of medievalizing socialism and “arts and crafts” came the most articulated alternative to the high-entropy path of industrial development: the Garden City.

A very different, although in some ways compatible, reaction to Viollet-le-Duc’s architectural and naturalistic interests developed into the various national strains of Art Nouveau. The construction of the Eiffel Tower (1885–89) stimulated such socialist architects as Frantz Jourdain, Victor Horta, and Henry van de Velde to seek a radical art form that utilized industrial processes while taking its structural and morphological inspiration (and usually its iconography) from nature.45 Jugendstil in Vienna and Munich, Modernisme in Barcelona, and the Glasgow circle of Mackintosh and Art Nouveau in Paris, Nancy, and Brussels all broke dramatically with historically bound styles to produce a sensual, transgressive style based on natural imagery—but it is clear that works such as Hector Guimard’s Paris Metro stations or Victor Horta’s Maison du Peuple in Brussels (both 1900), were designed to represent rather than interact with natural forces. The socially progressive brief of the latter institution was typically unconcerned with the question of high entropy in its efforts to advance socialist consciousness.

Art Nouveau mutated into subsequent strains of expressionist architecture, such as Bruno Taut’s crystalline Glass Pavilion at the Werkbund Exhibition in Cologne (1914), van de Velde’s theater for the same event (1914), or Erich Mendelsohn’s Einsteinsturm in Potsdam (1917–21), each of which are suggestive of natural forms but, like their Art Nouveau forebears, are not contingent on a reintegration of architecture with natural process. Taut as an exponent of both Garden Cities and expressionism came closest to an organic theory of environmental design, charted in his utopian manifestos of Alpine Architecture, the Crystal Chain, and the Dissolution of Cities. Architecture was proposed as a spiritual catalyst that would help engender the new synthesis of society and nature.46

The naturalistic treatment of form did not necessarily perform more ecologically but nonetheless was important in influencing consciousness toward a theory of

Richard Ingersoll
holism. This ideal reached its fullest manifestation in the buildings designed by Rudolph Steiner for his anthroposophical community in Dornach, Switzerland (1908–27). Steiner, an Austrian philosopher, was the leading authority in his day of the work of Goethe, and wrote extensively on Hegel, Nietzsche, and, most important in this context, Ernst Haeckel. From Goethe’s theories he would elaborate that “a product of art is no less nature than a product of nature, only the lawfulness of nature has already been poured into the product of art in the way this lawfulness appeared to the human spirit.”

In 1913, Steiner seceded from the German Theosophical Society to found his own Anthroposophical Society, a movement that has been fundamental to many environmental activists. Steiner was adamant that buildings express organicism in order to achieve harmony with nature and with the human spirit. Of the First Goetheanum (1913–22), the double-domed central meeting hall of his community, he wrote: “The entire building is conceived out of the whole. Every single form in this organically conceived building..., in that it represents a part of the whole, must make evident in its own form that it is indispensable... as manifestly indispensable as the lobe of the ear, or an arm or a head is to the human organism.” Such a claim approaches Alberti’s analogue yet attempts to invest it with a new holistic understanding of nature. Steiner theorized such architectural elements as a “living wall,” which would demonstrate the characteristics of the earth’s surface, a theory that led him to the design of double curved planes to show the counterbalancing forces operating in nature. Right angles were almost completely eliminated in his designs. The Second Goetheanum was executed in fireproof reinforced concrete upon the same principles with very different formal results, resembling alpine rock formations. The architectural solutions of Steiner’s so-called spiritual functionalism were unmatched in originality, but whether or not the organic forms had a beneficial influence on the human psyche, as was claimed, did not hinge on their being closer to natural process. Steiner’s greater legacy to ecology, it must be admitted, was in the realm of education and horticulture, the latter following the most radical ecological position of biodynamic farming. His buildings theoretically respond to the ecological imperative that was developing from biological theories, but they still conformed to the analogical tradition in architecture, representing natural processes rather than sustaining them.

**Utopian Efforts to Redeem Industrial Society**

The difference between the stylistic developments of Art Nouveau and the theory of Garden Cities put forth by Ebenezer Howard in his tract *To-morrow, a Peaceful Path to Real Reform* (1898) during the same period is tantamount to the difference of genotype to phenotype — that is, the organic process of growth versus the
appearance of its full-grown product. Although Howard's Garden Cities program is often misconstrued as one of the sources of the sprawling American suburb, and thus inimicable to sustainable strategies, it was in its origins the most completely detailed alternative to suburban developments from social, economic, and infrastructural points of view. In his diagram of the three magnets, Howard depicts a new synthesis of town and country, where the high level of culture of a large city can be maintained with a commitment to preserving natural processes in a managed working landscape.\(^{50}\)

The Garden Cities goal was to plan an entire region with regularly spaced towns. In each town the buildings would be clustered in an area of roughly a thousand acres for a population of thirty thousand residents, and would be surrounded by about five times that amount of land for agricultural and industrial functions. Local industrial and agricultural production were meant to supply this small region with most of its consumer needs, thus circumventing the centralizing tendencies of the chain of command of the metropolis. The hint found in Leonardo's scheme for Milan and More's organization of Utopia as a system of rationally planned settlements that preserved the proper balance between working lands, production spaces, and housing was fully developed into a modern vision that theoretically would greatly reduce wasteful urban development.

The experience of Letchworth, the first Garden City planned by Raymond Unwin and Barry Parker in 1904, demonstrates at once the formal success of low-density neighborhood planning and the difficulties of adhering to principles of cooperative ownership. To avoid speculation, the land was originally to be collectively owned so that the coherence of the plan could be guaranteed by the lack of competing land ownership. Located on 3,800 acres thirty-five miles south of London, Letchworth attracted about 8,500 people by 1914, and included Ebenezer Howard himself as one of its residents. Due to the diverging aspirations of reform movement residents, who lived there with a certain righteous agenda, and working-class residents, who did not share the same ideals, the town never coalesced into a community.\(^{51}\) The aesthetic of winding streets and neo-cottage style architecture derived from the Arts and Crafts movement, however, added another dimension to Letchworth that was easier to export than its cooperatively based plan. Subsequent suburbs, including those designed by Unwin, borrowed heavily from the formal ideas without including the social, economic, and environmental premises of Howard's Garden City. Without the structuring benefits of protected green belts and regional infrastructure, and without the development of a local economy and cultural base, the compromised garden city became a hapless agent of sprawl, which in its dependency on center city institutions and polluting transportation devices, reversed its potential for lowering entropy.\(^{52}\)

The theory of bioregionalism, which is still much debated among environmentalists, influenced Howard and was transmitted by him to others. Bioregionalism...
was formulated in the 1880s by utopian land reformers, such as the Russian anarchist Peter Kropotkin, as the project of human settlement according to a more natural distribution of resources in a complex biological system that shunned arbitrary political and ethnic boundaries in favor of natural units. Bioregionalism was expanded upon by the Scottish biologist and city planner Patrick Geddes in the first two decades of this century and was championed by the American critic Lewis Mumford as the path of redemption from the ills of the sprawling conurbations. While the attendant theories of urban decentralization had a large impact on the planned economies of the Soviet Union and other socialist states, the parallel path of intensive industrial development usually overcompensated the ecological advantages of such planning with ruinous results.

Perhaps the only instance of coordinated regional planning to approximate the bioregional and Garden Cities ideal occurred in the Jewish settlements in British-ruled Palestine, which after 1948 became the state of Israel. Patrick Geddes was in fact involved in the planning of Tel Aviv, Jerusalem, and Haifa during the first years of the 1920s. In successive years there would be greater influences coming from the radical culture of Germany and Eastern Europe. Although it is now difficult to dissociate the colonial immigration of Russian, Polish, and German Jews to the Middle East from the major international conflicts in that region, the initial dream of Zionism, set forth in the utopian novel by Theodor Herzl, *Altneuland*, was based on a benign insertion of collectivism, stewardship of agricultural lands, and high technology. The kibbutz movement, which was generated by mostly Russian and Polish socialists around 1910 and formally institutionalized in 1920, projected the settlement of communistic villages, with characteristics not unlike the towns of Utopia. The size of each commune was initially set at about a hundred members, but soon debates opened for communes with a thousand members to allow for a greater division of labor. The distribution and planning of these democratically managed, collective agricultural (and later light industrial) settlements was decided first by the Jewish Agency, which owned all the potential sites, and after statehood by the state planning bureaucracies. That the placement of these villages was determined as much by strategic defense as by biological considerations is due to the historic political situation of the region, and it offers a good example of why bioregionalism can never be fully implemented in a world governed by political and military priorities.

The kibbutzim, of which there are currently over 270 (housing less than 3 percent of the population of Israel), are enduring examples of collective living and landscape preservation. Automobiles are left at the edges of the settlements and not used internally; the inner core is laced with bike paths, reducing most paving and producing a remarkable atmosphere of tranquility in a space where a diversity of activities, almost as complex as those of a city, occur. The kibbutzim, although they are mostly secular, would never have lasted as collectivized environments...
without a highly motivated and ethnically based sense of purpose. This makes the kibbutz a limited model for replication. The rest of Israel, which was generally not developed with the same criteria as the kibbutz (as much as the early planners of the state, who mostly came from kibbutzim, desired), demonstrates the typical imbalance of development due to Westernization, modernization, and advanced capitalism, as found elsewhere on the planet.

The efforts of utopian settlements to resist the effects of industrialism have been relatively ineffective in curtailing the rampant waste of human and material resources. While the modern movement in architecture is usually associated with the ideal of mass industrialization and is often too easily dismissed as ecologically insensitive, several issues dear to present-day environmentalists, in fact, were central to the architectural agenda of most modernists. In particular, the preservation of green spaces and the analysis of solar orientation became canonic. Victor Olgyay's treatise, based on research begun in the 1920s, is a compendium of modernist knowledge on solar orientation. In addition, the modernists promoted an ideal of fair housing, rarely separating the social from the environmental. In Weimar Germany the garden city concept evolved away from the bourgeois estate of individualized villas into the movement for social housing estates and allotment subsistence gardens for the workers. During the mid-1920s the planning of long strips of apartments, the Zeilenbau, put into practice by Ernst May in Frankfurt and Bruno Taut, Martin Wagner, Walter Gropius, and others in Berlin, were geared to solar orientation and collective services, such as laundries, and were always provided with allotment gardens. German Social Democratic planners usually established these estates on cooperatively owned land to avoid speculation. Lembrecht Migge's theories of intensive horticulture for increased densities were well known, and his concept of the "growing house," which predicated a basic plot for growing food with a two-room unit that could be expanded in several directions, was widely copied. These Social Democratic planning efforts went toward the reorganization of the industrial city into a "green city," but unfortunately the green zones were not defended by successive administrations of planners, and today these housing estates have become almost indistinguishable from sprawl. The functionalist architecture of this period, best represented by the Zeilenbau projects, was obsessive about the issue of solar access, to the point of being heliotropic. In the name of function the architects would often reduce the concept of architecture to one of solving a single problem, such as solar orientation, without addressing other traditional functions such as circulation, the street, or scale. The most common urban approach called for a scraped site, or tabula rasa, which eliminated the contextual factors of the environment, wiping out with one hand what was trying to be conserved with the other.

The functionalist approach was pursued on an urban scale and developed into wedge-shaped enclaves by Ludwig Hilberseimer, one of the ideologues of the Ger-
man Social Democratic housing movement, in The New City, a book he published in reference to American cities in the mid-1940s. A basic L-shaped house unit with its own garden was plotted on a cul-de-sac which was joined to a series of fish spines radiating from a major transportation node. Parkland and space for public institutions such as schools were tucked between the spines in the green swards. The wedge was located upwind from polluting industries placed in an opposite quadrant, with farming protected in the remaining two quadrants. The new towns movement in social democratic administrations after World War II in England, Sweden, and Holland, in particular, resulted in many comprehensively planned towns, such as Harlow or Vallingby or Almere, where transportation has been intelligently organized, the pedestrian well provided for, and working landscapes safeguarded. A fairly universal critique of these places is that while they are more ecologically organized to sustain life, they are socially and culturally sterile. New towns have a difficult time, even after a large population has settled in them, creating enough cultural initiative or human diversity to generate and sustain an interesting urban culture.

Utopian planning has contributed formally and ideologically to the debate on how to organize human life and should not be automatically discredited as a source for obtaining principles. It is the inability of utopias to cross from the imaginary into the real that makes them useful for discussion but suspect as actual places. More's paradoxical etymology for the name Utopia—"no place"—is fundamental to its didactic function.

**Masters of the Organic**

Probably the two greatest influences on architectural theory during the first half of the twentieth century, Frank Lloyd Wright and Le Corbusier, each had a more than casual interest in natural factors. Luis Fernández Galiano attributes this not solely to the moral imperative of environmentalism but to the transcendent metaphysical function of energy in the conception of architecture that had particular appeal to the mythopoeic methods of both architects. Despite their mutual interest in Ruskin, neither of these architects rejected industrialism—Frank Lloyd Wright in his 1901 essay, "The Art and Craft of the Machine," advocates a new synthesis with the machine, and Le Corbusier from 1920 until World War II posed as an evangelist of technocracy—but both had visions of the structural reorganization of society that would be less wasteful and provide better protection of the natural environment. While it can be quite successfully argued that the application of their automobile-based models of urban organization—one the sprawling Broadacre City, the other the highrise-based Radiant City—have resulted in higher entropy, that was not the intention. Le Corbusier advocated greater density than in the traditional city; Wright demanded an end to that density and the spread across
the landscape of single-family Usonian houses, each on an acre of productive land. The fatal flaw in both their visions was what in retrospect seems to be the inevitable privileging of the automobile. The traditional street, and with it the preservation of human scale, was eliminated to favor the mechanical space of transportation.

The Corbusian model, although it looks much more alienating, and certainly the many derivatives of it have proved aesthetically awkward and functionally incomplete, was theoretically more ecological, since it wasted less land and concentrated services. Broadacre City proposed that most of its inhabitants participate in some form of agriculture, as Wright himself did at Taliesin East, in order to contribute to the autonomy of the family unit and reduce demands on centralizing economic structures, which, because of the incompetency of large-scale bureaucracies, are wasteful.

Aside from their utopian visions, both architects also produced buildings that actually integrated natural processes in their designs. Le Corbusier, disenchanted with his own attempts at artificial climate control, developed the brise-soleil (sun-breaker) in the 1930s as a means of naturally shading and ventilating buildings in a Mediterranean climate. He built several houses with sod roofs, one of the best bioclimatic solutions for retaining thermal comfort. His mother’s house on Lake Léman (1924), the houses for the Jaoul family in Neuilly (1952-56), and the Sarabhai House in Ahmadabad (1956) all have this feature. While many of the buildings Le Corbusier designed in India are inappropriate for the climate, unable to deal with the hot winds of the fall season, he usually attempted to mediate the climate with innovative forms that were poetic reactions to traditional forms. The concrete screens shading the front of the Justice Palace at Chandigarh, for instance, are gigantic extrapolations of wooden masharabiyya screens used to shield windows in many Middle Eastern countries. The Mill Owners Association in Ahmadabad, a building that has proven to be uninhabitable for three months of the year because of its failure to keep out warm winds, was planned to have a water-filled pool in the scoop of its umbrella-like roof to act as a natural cooling device. During the last two decades of his life Le Corbusier shifted his metaphors from machine age to biological; the “machine for living in” was replaced in his rhetoric by “the biology of the house.” The free-form shapes found in his last buildings, such as the lobes on the Carpenter Center in Cambridge, are biomorphic expressions, and many of the features, such as the “aeratur” slit windows designed to breath in cool air, are meant to make the structure behave according to biological processes.

Frank Lloyd Wright, who for much of his career specifically used the term “organic architecture” as a catchall for his theory of architecture, was generally more successful in the energy performance of his buildings. The Robie House of 1910 was not only interesting for its innovative pinwheel plan, but also for its astute solar orientation, a feature that became programmatic in all of his later work. The Usonian house was Wright’s answer to affordable housing during the Great Depression.
Depression, and it was supplied with many energy-efficient features. The first prototype, constructed in 1936 for Herbert Jacobs in Madison, Wisconsin, was a model of solar orientation. The L-shaped plan situated the major windows to the south, with mass elements and clerestories on the north. Most of the Usonian houses were proposed as partially mounded houses with good southern orientation and carefully calculated shading.\textsuperscript{68} In particular, Wright's Second Jacobs House (1943–48), for the same client as the first Usonian house, is a textbook example of passive solar heating and cooling. It is a two-story structure built into a mound on the north that rises to the second level to provide thermal mass. The hemicycle plan is oriented to the south, with a roof overhang that keeps the summer sun out and lets the winter sun in. Air circulates freely from room to room, each room being open to the south. Air also circulates between floors, as a gap has been left between the glazed south wall and the floor separation.\textsuperscript{69}

Like Ruskin, Wright founded his own utopian community of Taliesin for absorbing eager young apprentices into a communal existence. The summers were spent in Wisconsin, the winters in Arizona. Taliesin was an architectural office in which the job tasks could include milking cows, tending the vegetable garden, and canning fruit. The members of Taliesin lived according to the rural ideals expounded for Broadacre City. Taliesin West, near Scottsdale, Arizona, built in the late 1940s, was meant to passively mediate the winter climate of the desert; it is partially submerged, and the pitched wooden rafters originally supported a canvas roof, in principle a tent, that provided natural illumination and good climate control (except in the rare case of rain).\textsuperscript{70}

While their urban models are seriously flawed, the explicit concern for reducing entropy in the late works of both Wright and Le Corbusier heightens the complexity of these works. That ecology is not the most evident determinant of the design of these works has allowed them to be considered according to the conventional aesthetic criteria of the anonymous discourse of architecture; however, as the terms of valuation shift, they may gain new status as prototypes for a sustainable environment.

**The Solar Stigmata of the Ecology Movement**

There is an ironic serendipity in the proliferation of solar collectors, attached to buildings with functionalist conviction in the 1970s, and the deconstructivist taste for fragmentation in the 1980s, when an aesthetic based on dismembered bits of metal trusses that could have carried solar panels but didn't was widely admired. (A synthesis finally occurred when the Benisch & Partner office hired a designer from Coop Himmelblau to work on the Hysolar Institute in Stuttgart in 1988 and placed solar collectors on the extruded parts of the building.) Solar buildings pro-
duced during the 1970s caused a certain embarrassed revulsion because the awk-
ward solar technology overpowered the architectural program and form, reducing
design to something less than the sum of its parts. Ecological architecture built
since the energy crisis carries the stigma of solar collectors and generally suffers
from the same positivist logic of functionalist modernism, by which the complex-
ity of architecture as an aesthetic, urban, and structural system is reduced to solv-
ing prioritized functions.

Although there had been a thriving industry producing solar water heaters be-
fore World War II, their poor efficiency (ten-year life expectancy) and the low price
of postwar electricity made them economically obsolete. The resurgence of solar
heaters during the 1970s energy crisis was thus an unacknowledged revival. There
had been an earlier generation of solar architecture, proposed initially between
1938 and 1958, when scientists and architects at MIT collaborated on four experi-
mental solar houses that used active equipment for gathering and storing solar
radiation. The principles of these systems were developed from Horace de Saussure's heat trap, or "hot box," introduced in 1767. He based the design on observ-
ing glass-walled conservatories. An insulated box with three layers of glass when
left in the sun could reach a temperature of 230°F. The MIT group perfected the
copper-coiled mechanism invented by Edward Morse in the 1880s for rooftop so-
lar collectors and added innovative storage tanks, a feature that proved to be un-
economic. In 1947, Dr. Maria Telkes and the architect Eleanor Raymond collabo-
rated on a house, the Dover House, that used glauber salts, which could absorb
seven times as much heat as water or crushed rock, as a means of improving heat
storage. But until the development of photovoltaic panels in the 1970s, it was im-
possible to guarantee complete heating needs through solar devices in northern
climates. The expense of solar houses could not compete with those heated by
fossil fuels, and the research program was discontinued.

During the 1960s a significant change of consciousness occurred, and the sub-
sequent demand for solar energy was championed not from an economic perspec-
tive but from one of social responsibility. Most important in this shift in mindset
were the jeremiads of Rachel Carson, who in The Silent Spring (1962) exposed the
extent to which the pesticide DDT had penetrated the world's ecosystems and
launched the general challenge to think of pollution as a global problem. Tangen-
tial to this were the Civil Rights movement and the movement to ban nuclear
weapons. Ecology became an ethical position at that moment, and it was one of
several political issues that shook the established ideology of progress based on
the expansion of military and industrial technologies.

The reactions to the first wave of environmentalism were multifarious, ranging
from reforms within the profession to anarchic utopian experiments. Ecology, al-
though it had been used in science for several generations, was not explicitly ap-
propriated by architecture until the 1950s, when Richard Neutra made it the cen-
tral focus of his writings on architecture. Neutra built a series of desert houses in California that use architectural and landscape features to naturally mediate the climate. Lewis Mumford had been preparing a critical terrain for the ecology movement since the 1920s with his steady stream of attacks on urban policies and machine civilization. His most devastating critiques of the military industrial complex were published in the late 1960s in the two-volume *Myth of the Machine*. Serge Chermayeff allied his studies of the relationship of community formation to Mumford's environmentalism at this time. His thinking was influenced by gestalt research in cognitive theory and aspired to an architectural theory of holism. *The Shape of Community*, written with Alexander Tzonis in 1971, was one of the first academic attempts to promote a theory of architecture based on multidimensional environmental considerations.

Two projects by Roche and Dinkeloo, the Oakland Museum (1963) and the Ford Foundation (New York, 1967), serve as emblematic responses by official culture to the environmental movement. In each case a symbolic garden is integrated into the building's program and offered as a public landscape. The Ford Foundation, which has an immense atrium garden, is, in fact, energy inefficient, since the garden necessitates extra climate control machinery. Such practices are a form of ecological tokenism, and once again natural conditions are represented rather than sustained.

Chermayeff's most famous student, Christopher Alexander, first devised a systems theory of decision making for architectural form that was close to cybernetic theory before converting his holistic method to more subjective, quasi-mystical criteria. *A Pattern Language*, written with six colleagues and published in 1977, is a veritable treatise on ecologically responsible design. It prescribes 253 rules, ranging from the scale of the region to that of the inglenook. As a theory it is intricate and ingenious in guiding the complex interrelationship of various design factors, but is seriously flawed by the insistence on universals that generally have been deduced from an ethnocentric analysis of the built form of traditional cultures. Alexander's attempt to generate a system of building procedures that is analogous to natural processes, where everything is connected to everything else, is, nevertheless, a conceptual breakthrough that seriously challenges the role of authorship in architectural design while questioning the validity of industrialized methods of production of the environment. Like the theories of Ruskin, Taut, or Steiner, his theory has a metaphysical platform that advocates the isomorphism between the human spirit and architectural form. It is not possible to properly construct buildings according to Alexander's pattern language until the overall system of production changes. The theory is thus unrealizable in its anticipation of redemptive circumstances, and has a latent suggestion of cultist control in the insularity of its logic. Although the rules of the pattern language are meant to insure variety, their application infers an authoritarian mandate.
Probably the most widely used ecology-inspired text of this period was Ian McHarg's treatise on landscape, *Design with Nature* (1969), which created an awareness of geographic and natural features as elements of conservation. One of the largest applications of McHarg's methods was partly implemented at The Woodlands, a 25,000-acre new town on the edge of Houston, Texas, developed in 1971. McHarg advised the planners to avoid clear-cutting of trees and to enhance the paths of natural drainage, locating golf courses and other recreation facilities on the flood plain land. The first residents left a completely natural landscape around their houses, without front or back lawns, but this practice has been discontinued. While such an approach can be seen as relatively benign at the level of microclimate, the spread-out design of The Woodlands forces residents to drive for all their basic needs—school, work, and shopping—and thus does little to reduce daily contributions to high entropy. Saving a tree may not in the end be as environmentally astute as saving a trip.

Paolo Soleri, an Italian student of Frank Lloyd Wright, produced a visually stunning utopian theory called "arcologies" in the 1960s. He proposed a synthesis of architecture and ecology. His argument, illustrated with preposterous megastructural projects for urbanizations in the air, below ground, and in the sea, each with a glorious Old Testament-sounding title, such as Noahbabel, is similar to Le Corbusier's desire to raise buildings off the ground and have people live in denser settlements so that services can be concentrated. Like a prophet, Soleri fled to the desert to construct Arcosanti, a demonstration community near Phoenix, which has been built mostly through the volunteer labor of architecture students since 1970. Arcosanti, which has immense concrete exedra hugging the cliffs of its site, is true to much of the formal promise of the arcologies models but does not make a convincing model of ecological or community organization because it is based upon geographical, economic, and social marginalization. Like all generalizing utopias, it is a victim of its own specificity.

At the other end of the spectrum, such mainstream architects as Richard Stein tried to reform the conventions of practice. Long a member of the Sierra Club, Stein formed a study committee on environmental issues within the American Institute of Architects (AIA) in the late 1960s that led to the publishing of *Architecture and Energy* (1978), a thorough examination of how energy performance can be analyzed and improved. The Department of Energy was established in 1971, and standards for energy efficiency were developed during the decade that greatly reduced energy waste. Funded research and sponsored competitions during the 1970s led to computer programs to analyze the performance of buildings and improved thermal devices, such as double-paned windows filled with argon gas.

In California, Governor Jerry Brown appointed Sim van der Ryn as state architect to develop a series of programs that would popularize ecology-conscious building practices. Van der Ryn had been one of the founders of the Farallones Insti-
tute, which produced the Integral Urban House in 1974, a lived-in exhibition of sustainable dwelling techniques fit into a conventional Victorian house on an urban site in Berkeley. During his tenure six energy-efficient state office buildings were constructed to demonstrate the advantages in comfort and cost of maintenance of passive systems. The Bateson Building in Sacramento is an attractive alternative to bureaucratic office buildings. It relies on vernacular solutions, such as planted trellises and shaded courtyards, as well as technologically innovative passive devices, such as suffusing screens to augment the distribution of light. Since their design, other issues such as indoor air pollution have altered even further the standards for environmentally sound office buildings.

The oil embargo of 1973 created a frenzied demand for alternative energy solutions. Solar collectors became a symbol of environmental righteousness; President Jimmy Carter had some solar collectors installed to heat the White House swimming pool almost as soon as he took office to show a personal commitment to the movement. Hugh Stubbins’s Citycorp skyscraper in New York City (1977) was designed with a dramatically sliced, solar-oriented top to demonstrate corporate support, but this was in fact a bluff since the solar panels were never installed, making it an empty symbolic gesture.

As part of the solar movement, Judy and Michael Corbett developed and designed a solar subdivision called Village Homes on seventy acres in Davis, California. Using some of McHarg’s precepts, they reduced the width of the streets, exploited natural ground swales for drainage, and sited all the houses with southern exposures. The landscape needs a third less watering, and the solar features account for 50 to 75 percent of the heating. The success of the development did not lead to others like it, because short-term costs have remained a much higher priority than lowering entropy. The satisfaction of Village Homes is in the realm of energy consciousness and community values (very few of the original owners have moved), but not in architectural quality. The “wood butcher” ethic that set itself as the ecological subversion of architecture did as much to prevent a change in consciousness as the profession’s own reluctance to accept reform.

Recent buildings that have been designed to perform environmentally are usually uninspiring from a formal point of view. Most of the examples illustrated in Brenda and Robert Vale’s *Green Architecture* (1991), for example, are either frightful neo-Steinerian excursions into resisting urban order, such as Alberts and Huut’s grotesque NMB Bank in Amsterdam (1983–87), allegedly the most energy-efficient office building in Europe, or are well-meaning but awkwardly detailed retreats such as Amory and Hunter Lovins’s Rocky Mountain Institute (1983, Aspen, Colorado). Only a few works, such as Glenn Murcott’s Kempsey Museum in New South Wales, or Clark and Menafee’s Middleton Inn near Charleston, or the Carraro House by Lake Flato in San Antonio, promise to combine ecology-conscious design with a synthesis of good details, expert proportional relationships, and a
spatial order that would demand one to consider it culturally. Such works address the autonomous aspects of architecture while functioning well with thermal and fluvial conditions.

There are, of course, many more buildings that behave in a converse manner, where poor environmental performance is masked by inspiring form. Helmut Jahn’s Illinois Center in Chicago or Richard Meier’s High Museum in Atlanta are two of the more egregious examples: because of overexposed glazing they provide a preview of the greenhouse effect.

One of the few environmentalist-oriented projects where the design communicates more than just its teleological relationship to place and climate is Sea Ranch, a ten-mile stretch of Northern California coast, planned by Lawrence Halprin in 1964. The natural features of the rugged landscape were preserved by clustering the buildings at the edge of the clearings and leaving large meadows and undisturbed sea cliffs in between. The architects Moore, Turnbull, Lyndon, and Whittaker, who designed the initial condominium complex, and Joseph Esherick, who did several houses, played with a limited palette of materials and single-slope shapes to create a recombinatory vernacular derived from the wood-slat demeanor of local barns. A code for the rest of the buildings at Sea Ranch was developed from their initial designs, but the dwellings constructed over the past twenty-five years have not maintained exactly the same sense of harmony with the natural surroundings and with the original buildings. For all its excellence as an example of how to build with nature, Sea Ranch, it must be remembered, is a vacation resort, an indication that most conscientious approaches to the environment happen best in marginal spaces of luxury and are often motivated by a desire for atonement for the polluting circumstances that created the surplus needed to finance such places.

The first wave of ecology consciousness in architecture led to reforms in building codes, utopian fantasies, and the proliferation of solar panels that stigmatized it as trivial in reference to the larger discourse of design. The emphasis on functional criteria limited the understanding of ecology as a primarily technical matter. In the reduction of entropy through the use of appropriate technology, in the contribution to urban life, and in the maintenance of a community’s equilibrium with the land, ecological values have the potential to transfuse new meaning to Le Corbusier’s lyrical definition of architecture as the “masterful, correct, and magnificent play of forms in light.” The energy of that light can only strengthen the greatest game of civilization, the art of architecture.

The Ecology Question

Despite the technical and biological issues concerning architecture and ecology, the attempt to restore the ecological balance of the biosphere can be viewed as having profound social relevance. In effect the very means for exploiting and con-
trolling the natural environment are no different from those that have been used to exploit and control the social one. The “Ecology Question” in current architectural discourse is analogous to “The Housing Question” formulated by Engels during the nineteenth century. The Housing Question, an issue that arose in regard to the demand for fair and healthy housing for all, served as one of the most powerful critiques of capitalism and was instrumental in mobilizing a consciousness of social responsibility among designers and architects. Most modernists felt a certain unity of purpose, a naive belief in the good intentions of their various attempts to resolve the housing question through architectural means.  

In terms of a socialist revolutionary strategy, Engels had great reservations about a struggle waged through housing reform, since the supply of good housing once achieved would placate the revolutionary momentum; it thus was criticized as a tactic of the liberal reform of capitalism, like treating the symptoms without changing the system. A project such as Karl Marx Hof in Vienna, which is expressly ideological in its name and iconography, must be seen as an attempt to respond to Engels’s critique: it was proposed as good housing that would also perpetuate the revolutionary rhetoric of the working class, and even become a literal bastion of class struggle against the state. 

Ecologists, who call for a transition from the dominant Western mentality of anthropocentrism to one of biocentrism, rarely take into account the immediate social injustices that also demand solidarity. The neo-Malthusians are thus able to interpret starvation in remote quarters as a natural process not to be interfered with, while never doubting the primacy of their own well-fed being. One of the major issues articulated at the Earth Summit in 1992 was the matter of environmental justice, whether in reference to poor countries receiving the toxic waste of wealthier ones or poor neighborhoods suffering the same. 

The Ecology Question has the potential for generating one of the deepest critiques of late-twentieth-century capitalism, especially since the demise of official Marxism. But just as the social housing created in the name of the Housing Question has led to some of the more egregious failures of modern architecture—it became the crucible of the functionalist fallacy—the architectural response to the Ecology Question runs the same risk. A green functionalism promises to lead to a similar treatment of symptoms and an unrealistic retreat from a system that has not been changed. The attempt to restore the ecological balance of the biosphere has profound social relevance. If urban planning and architectural policies are reduced to mechanical solutions based on cause and effect rather than being grounded in a social conception of ecology, they will not easily adhere to a frame of social justice. 

Such a consideration is programmatic rather than projectual. The effectiveness of an architecture that emerges from the Ecology Question will depend on the handling of two other factors: (1) the social and political nature of cities in which
buildings are built; and (2) an acknowledgment of the rhetorical nature of architecture. The functionalist fallacy that was present in the planning and architecture projected in response to the Housing Question failed regularly on those two accounts, in particular.

The infamous social failures of public housing during the past three decades are blamed on functionalist fallacies and help detract attention from the fact that the demand for social housing still exists. The ever-worsening environmental crisis will probably supersede matters such as housing, and in the near future the housing question will be subsumed into a greater ecology question. As with the old functionalism, it will have benign intentions but will probably mask the potential for a new code of repression. The higher sense of responsibility toward the environment lies not in the solutions but in the formation of the question. Can there be such a thing as ecological balance if it is not socially determined? Is not human consciousness the major component both of the cause of the imbalance and of its possible rectification?

The Ecology Question, if it is not proposed as a question of justice among humans, will in the short term risk continuing to be submerged, and thus in the long term will require drastic, and probably inhumane, palliatives. Designers and planners should recognize that each act of design not only plays a part in the balance of the environment but also is dependent upon policy, and that a strategy at both levels that does not include the self-determination of communities and the social reintegration of life functions will most likely contribute to repressive consequences analogous to those engendered by so many of the functionalist public housing projects. The Ecology Question as a socially based priority asks that design and planning conceive of sustainability and social justice as reciprocal conditions— that saving the planet and saving the community become inseparable.

**POSTAPOCALYPSE DESIGN**

The forecast of a green apocalypse has been used as a scare tactic that forces an interpretation of all uses of energy in apodictic terms. Malthusian anxiety about population explosions and alarmist predictions of heat death provide external pressures that cannot be easily translated into architectural terms. Perhaps the anxiety and paranoia that have served as key inducements to support the ecology movement could be replaced by more life-enhancing values if it were admitted that the green apocalypse has already occurred and that it is no longer a question of saving humanity from extinction and the planet from heat death but rather of slowing down that eventuality. Reform through volunteerist example and propaganda and reform through democratic process have succeeded in lowering the emission of air pollutants only 18 percent during the last fifteen years. While statistically it can be shown that because of the environmental policies of the 1970s great progress
was made in saving energy, the same statistics will also reveal that no progress has been made in reducing net entropy, because development has increased exponentially. For every BTU of energy saved through better insulation and proper solar orientation, the same amount has been squandered in other forms of consumption, mostly related to the Western way of life. While the circumstances seem dire, the most extreme reactions to the green apocalypse, those in which the rights of biotic communities are placed above those of humans, often verge on dictatorial conclusions and run the risk of advocating ecofascism.83

In the postapocalypse era, ecology is already being reconsidered as a social issue about the organization and maintenance of life. Technology is no longer anathematized, but is seen as something that must be artfully mediated and used more efficiently in order to regain a better equilibrium with natural processes, an attitude that has been adopted by hard-line ecologists through the spread of computer use. Instead of cultivating the paranoia of self-sufficient ecological correctness, the second wave of environmentalism, which emerged in Europe in the mid-1980s, is much less prone to utopian experiments and more to direct political engagement. The issue of ecology is being shifted from the realm of individual buildings and individual consumer choices to collective choices, since it is the performance of cities and urban organization that has the largest impact. There is no single solution for cities, which are complex interactive environments; solar collectors or conscientious recycling will not save people from driving to work. In postapocalypse times there can only be transitional strategies in urban situations, and these are as much political as they are technological.

While high entropy is a relatively recent, quick-breeding phenomenon in the history of human settlement, the struggle for sustainability will take much longer to effect. In some ways the fact that nature is no longer pure has helped to root ecology into architectural discourse. Even cynical theorists, such as Peter Eisenman, who has made a career of denying that architecture is a socially benign activity, have incorporated interpretations of natural phenomena such as chaos theory and rhyzome analogues because of the consensus of a merging of inorganic and organic.84 Ecology, or what could be called today “the interrelationships of things in a natural world that has been altered by humans,” is closer to the center of architectural discourse than the built results would testify. It has penetrated the autonomy of architectural theory by way of contextualism, appropriate technology, urban conservation, energy conservation, and community organization.

In the critique of modernist tabula rasa, planning principles carried out in the mid-1960s, diverse architectural theorists ranging from Robert Venturi to Aldo Rossi to Colin Rowe to Leon Krier pleaded in varying degrees for contextualism: the defense of the scale and morphologies of an organism’s habitat. While only Krier has since pronounced himself an ecologist, and none of them would agree upon a definition of “habitat,” the postmodernist mission of emphasizing the city
as the nondeterministic generator of architecture has become a major element of architectural theory that bonds easily with a new ecological agenda. That most of the postmodernist generation of architects were absorbed into a cultural network based on the promotion of authorial images, however, seems to have inhibited their further potential for integrating ecological principles into discourse.

The major attempt to divert the co-optation of the critique of modernism into such commercial exploitation came from Kenneth Frampton in his proposition for critical regionalism. Without using the term "ecology," Frampton's theory is ecologically inspired. Misunderstood by many as a nostalgia for regionalism, Frampton proposed an architecture that resisted the wasteful regime of mass culture by specifying the materials and climate-mediating devices derived from local priorities. One of the main points he emphasizes is that it not be dependent on universal technologies such as air conditioners. Critical regionalism thrives on the marginality and difference already present in any geographic situation. It should appeal to the haptic rather than the merely visual, the tectonic rather than the scenographic; it should be connected to its site rather than hovering. Instead of simulating vernacular solutions, however, it must also be critical, addressing itself to something more universal through its refinement of the particular. Exactly how a building behaves critically while staying within the dictates of the region is not always clear, however, and does not lend an air of unity among projects that might qualify.

The question of what a building looks like, what other buildings or natural things it reminds you of, and what it represents is still of primary importance. This is why the rhetorical function of architecture is so important. A good building must convince one that it is good — it must have appeal as a cultural product as well as a phenomenal, sheltering device.

The transitional strategies for lowering entropy and improving urban organization can be found in many recent works. In the Montrouge district of Paris, Renzo Piano's firm has produced an office complex for the Schlumberger Corporation that has conserved a working-class district in a beautiful way. Instead of relocating to a far-off suburb where land is cheaper, the company decided to reuse the factory and warehouse buildings already on the site as offices. This kept jobs in the neighborhood and helped the district to retain its scale. The site was opened up by the removal of a few buildings, and a new parking structure was located under planted berms. A high-tech Teflon tent structure stretches over a gap in the berm to create a naturally lit, well-insulated social space for the company's coffee shop and other collective services. The old buildings were gutted and rehabilitated with exposed ducts and office spaces to obtain better circulation and access to natural light. The Schlumberger office complex enhances the environment through a beautiful garden by Alexandre Chemetov, while conserving buildings and neighborhood relations, including employment.
The Croxton Collaborative’s two rehabilitations in New York City, one for the Natural Resources Defense Foundation and the other for the National Audubon Society, do similar things in an even more conscientious manner. In the Audubon offices, located in the formidable Shermerhorn Buildings (1910), almost everything that was thrown away from the original building was recycled, 79 percent of the materials that come through the offices are recycled in separated chutes, and energy use has been reduced 60 percent through natural lighting. All the elements used were available off the shelf, making the technology appropriate rather than based on further development. Through the conservation of a significant building and continued energy conservation techniques, urban values have been maintained and a high level of comfort and beauty have been achieved. 87

New technologies and materials are working their way into a transitional approach to building, in particular the photovoltaic panel. Advanced Photovoltaic Systems Manufacturing Facility in Fairfield, California (1993), by Kiss Cathcart Anders, uses the items it produces as integral components and as a demonstration of easy adaptation to current mass building methods: photovoltaic panels provide an energizing wrapper.

In non-Western settings, where the question of natural and economic resources is doubly important, the theory of appropriate technology geared to time and place has emerged as a transitional strategy. In the new districts of Bombay, India, Charles Correa has designed the Belpur project for one hundred subsidized housing units with minimal resources. The scheme provides basic service cores that can be added to in two directions to accommodate growing needs. Rather than employ technologies that depend on energy-intensive resources that are not available locally, the construction is of modest, easy-to-assemble masonry blocks and tiles produced locally. The plan proceeds according to a game pattern of expansion clusters, with some protected areas for public space. The spatial patterns retain traditional relationships without mimicking traditional forms. 88

A transitional strategy for controlling metropolitan sprawl without scaring away the existing modes of development is currently being proposed as the key to reducing entropy. Peter Calthorpe is perhaps the most audible spokesman. In his book The Next American Metropolis (1993), he outlines a way to attract the same developers who are building suburban America and get them to build village-scale environments tied to good transportation networks. The scheme is self-consciously close to Ebenezer Howard’s Garden Cities, without the utopian aspects of requiring cooperative ownership of the land and an altered way of life. The “pedestrian pocket” allows for various options of transportation and housing. In a hypothetical pedestrian pocket, all buildings, which include a mix of apartments, single-family homes, offices, and retail space, are within a five-minute walk of a transit station. What distinguishes Calthorpe’s model from other suburban developments is that the land surrounding this enclave is protected by a regional plan for agri-
Mechanical Components
0 High efficiency gas-fired absorption heater/chiller serves air handler at each floor.
P Separate, mandated outside air system delivers 24 cfm per person.
Q Number of air changes (recirculated and filtered air) is 6.2 per hour.
R Moisture carry-through in system is minimized by low velocity (less than 500 fpm) as well as cooling coil configuration.
S Variable volume units at each perimeter office assure individual control and their arrangement in open office assures full “mixing” of air.

Lighting Components
K Daylighting photocell controls outer bay of lighting (full range dimming)
L All lighting is high efficiency, high color rendition fluorescent with electronic ballast (one ballast for two fixtures).
M Sensors at offices, conference room, etc., turn off lights when room is unoccupied (zone sensors for open area).
N Pendant arrangement of single tube fixtures with up/down components achieves 30 fc ambient light level with low glare characteristics overall.

Interior Planning Components
F Perimeter work stations are held to 3 ft. 6 in. to maximize daylight to interior.
G Open office area is organized east/west to take maximum advantage of daylighting.
H Colors for systems furniture and interior surfaces are in high reflectance range to maximize both natural and artificial light.
I Task lighting is incorporated as part of high efficiency task/ambient system.
J All work stations meet test method and criteria for offgassing of formaldehyde, volatile organic compounds, particulates, etc.

Architectural Components
A Full-height ceiling maintained at building perimeter to maximize daylight effect.
B Enclosed office grouped north and west with clerestory glass.
C Core elements (elevators, fire stairs, pantry and mechanical rooms) on north and east solid exterior walls.
D High thermal performance windows with high transmissivity of natural light.
E Exterior wall thermal upgrade (insulation) approximately three times code requirement (applies to all exterior walls).

Figure 3.1. Croxton Collaborative, National Audubon Society (1990), New York City.
cultural uses, and the automobile, although still a possible component, is no longer indispensable. Calthorpe’s concept was applied to the development of the Laguna Ranch subdivision in Sacramento, which is frankly indistinguishable from other developments nearby, but perhaps when it is integrated into the planning of larger parts of the city it will become part of a transportation strategy.
There are dozens of similar settlements designed by Andreas Duany and Elizabeth Plater Zyberk that return the order of the suburb to that of a village, the most famous being Seaside, Florida. The major difference in these latter examples is that they do not stress transportation links. A reversal of sorts has been envisioned for inner cities by Richard Register in his theory of ecocities, which predicts the de-development of the existing modern city, with a similar morphological outcome to the pedestrian pocket. He has projected a scenario for the city of Berkeley according to a 125-year span, from a spread-out grid system that denies most of the natural features, such as shorelines and creeks, to a series of dense urban clusters, where buildings are built taller and closer together than in the existing sprawl. The natural features are allowed to reemerge and urban agricultural zones are interspersed between the clusters. The automobile becomes less necessary as diversity of functions are brought into proximity in each cluster. Such a vision is less pragmatic than the pedestrian pocket because it is more confined by existing real estate values. If it were proposed for downtown Detroit it might sound more realistic.

These exponents of what is being called the “New Urbanism,” in their interest to proceed pragmatically, may be solving technical questions with their models but are ultimately contributing to the chauvinism of the American suburb, where good things happen to white, middle-class people. Such models unselfconsciously help reinforce the injustices of environmental discrimination and trivialize ecological...
planning as a luxury item, analogous to organically grown produce in the grocery store. There are other contexts where the free market of real estate has been coerced through a political process and the intervention of visionaries to include a more comprehensive social agenda, resulting in more equitable urbanizations. Both in Almere, a new town for 150,000 inhabitants thirty miles northeast of Amsterdam, and in Curitiba, a replanned city of 500,000 in the south of Brazil, remarkable transportation planning and fair housing programs have been combined into urban formations that reduce automobile dependency and preserve urban green spaces. Urbanization, although it is mostly under the control of developers and politicians, also requires the imagination of architects, planners, and designers to move beyond the technical and social givens to encourage a better and more equitable quality of life.

The attitude to urbanization is ultimately what will determine to what degree architecture can contribute to the reduction of entropy. The day may already be here when the notion of a good building is not only one that includes good proportions, clever details, sensible structure, and a sensitive interpretation of pro-
gram, but also one that comprehends energy performance and a project’s capacity to contribute to the public realm through its siting. To be ecological in a merely technical sense will not be enough to be good, but it can no longer be missing from the criteria of goodness. But most of all, for an architecture to be truly sustainable it will necessarily be inscribed in a new urban vision of social justice.

Notes


11. Martin Pawley, *Buckminster Fuller* (London: Trefoil, 1990), p. 116. Fuller’s great concept of “dymaxion” (the term was coined by a journalist) conflates “dynamic,” “maximum,” and “ions” to express a philosophy of “more for less” whereby progressive technology can yield greater potential from fewer resources, thus lowering entropy.


15. Leon Battista Alberti, *On the Art of Building in Ten Books*, trans. J. Rykwert, N. Leach, and R. Tavernor (Cambridge: MIT Press, 1988), p. 96. A few pages later (p. 99) he observes: “Any river flowing either to eastward or westward will not be all that unwelcome, because the breezes that arise with the sun will either disperse any harmful fumes passing through the city, or with their arrival, do little to increase them.” This sort of comment is about as naturalistic as Alberti will allow.

16. Alberti, *Art of Building*, p. 23: “If (as the philosophers maintain) the city is like some large house, and the house is in turn like some small city, cannot the various parts of the house... be considered miniature buildings?” For Alberti’s analogue of a ship, see p. 100.


18. Alberti, *Art of Building*, p. 196. The argument is used to sustain circular temple plans. “Nature also delights in the hexagon,” he adds. The reasoning is close to Plato’s *Timaeus*, which introduced the canonical geometrical figures.


20. On Filarete, see Choay, *La regola*, pp. 230–32. Filarete made a curious natural analogy of the building process to the patron impregnating the architect, who then gives birth to the building after nine months.


23. Simon Pepper and Nicholas Adams, *Firearms and Fortifications* (Cambridge: MIT Press, 1986). De Marchi’s was one of several mid-sixteenth-century treatises, including Pietro Cattaneo and Girolamo Maggi, that proposed geometrically composed city plans for efficient military defense.


29. Merchant, *Death of Nature*, pp. 236–40. The course of science, however, was by no means monolithic or without concern about the effects of entropy: John Evelyn, better known as Christopher Wren’s rival for the new, postfire plan of London in 1667, published a thesis on the problem of deforestation in 1662, one of the first appeals for a scientifically man-
aged forest in order to protect a vanishing natural resource; it led to a temporary program of reforestation in 1668. John Evelyn’s treatise was called Sylva, a Discourse of Forest Trees and the Propagation of Timber in His Majesty’s Dominions.


31. John Dixon Hunt, The Figure in the Landscape (Baltimore: Johns Hopkins Press, 1976).

32. Steven Marcus, Engels, Manchester, and the Working Class (New York: Random House, 1974). Toqueville in 1835 described it thus: “From this foul drain the greatest stream of human industry flows out to fertilize the whole world, from this filthy sewer pure gold flows. Here humanity attains its most complete development and its most brutal; here civilization works its miracles, and civilized man is turned back almost into a savage.” Quoted in Marcus, p. 66.


34. Berman, All That Is Solid Melts into Air, p. 40. The “tragedy of development,” as Berman calls it, is the tragedy of modernity, since “the only way for modern man to transform himself... is by radically transforming the whole physical and social and moral world.”


36. Charles Darwin, The Illustrated Origin of Species, ed. R. Leakey (London, 1986). Worster, Nature’s Economy, says Darwin is “the single most important figure in the history of ecology over the past two or three centuries” (p. 113).


39. Bramwell, Ecology, pp. 42–53; such thoughts on the political nature of biology were expounded in Haeckel’s The Wonders of Life (1905). In this same generation of scientific thought, Rudolf Clausius proclaimed the dominance of entropy over energy in 1865. Fernández Galiano, El fuego (p. 67), cites Clausius’s formulation: “Die Energie der Welt ist Konstant. Die Entropie der Welt strebt einem Maximum zu” (The energy of the world is constant. The entropy of the world strives to overcome it).


41. Henry David Thoreau, The Variorum Walden, ed. W. Harding (1854; New York: Twayne, 1962), pp. 42–60. Thoreau’s “functionalist” position is sounded in this statement: “What I know of architectural beauty I now see, I know has gradually grown from within outward, out of the necessities and character of the indweller, who is the only builder,—out of some unconscious truthfulness, and nobleness, without ever a thought for the appearance.”

42. Narciso G. Menocal, Architecture as Nature: The Transcendentalist Idea of Louis Sullivan (Madison: University of Wisconsin Press, 1981). Sullivan’s position is related to Emerson’s essay “Nature” (1836) and Viollet-le-Duc’s Histoire d’un dessinateur (1879), in which there is the line “And if one really wishes to understand this word beauty as something else beyond a convention or canon, the only way for it lies in the observation of the manner in which nature operates, not in the reproduction of an eclectic type. The beautiful is nothing more than the harmony, the exact correspondence, between form and function.”

154 RICHARD INGERSOLL
45. Klaus-Jürgen Sembach, Henry van de Velde (London: Thames and Hudson, 1989). Among the sources leading to the new abstraction of nature were Owen Jones's Grammar of Ornament (1856).
48. Ibid.
49. Wolfgang Pehnt, Rudolf Steiner: Goetheanum, Dornach (Berlin: Ernst & Son, 1991). Pehnt points out that the forms of the Goetheanum were not always integral to the structure.
51. Robert Fishman, Urban Utopias in the Twentieth Century: Ebenezer Howard, Frank Lloyd Wright, and Le Corbusier (Cambridge: MIT Press, 1982), pp. 64–75, describes the setbacks to cooperative life: "Despite Howard's hopes, the Garden City could not create its own oasis of social justice in an unjust society."
52. Mervin Miller, Letchworth: The First Garden City (Chichester, Sussex: Phillimore, 1989). Thomas Adams, the chief planner of the New York Regional Plan (1930), was the manager of works at Letchworth, and Patrick Geddes was a frequent participant.
54. Donald L. Miller, Lewis Mumford, a Life (New York: Weidenfeld and Nicholson, 1989), pp. 197–200. Mumford wrote "The Intolerable City" in 1926 and accused the Megalopolis of being unable to support itself as an organism, fostering ecological imbalance. The idealistic subdivision of Radburn, N.J., begun in 1929 on designs by Clarence Stein, was one of Mumford's pet causes for an American Garden City.
55. Marshall Stalley, ed., Patrick Geddes: Spokesman for Man and the Environment (New Brunswick, N.J.: Rutgers University Press, 1972). Geddes made the first plan for the Hebrew University on Mount Scopus in Jerusalem. Although Geddes worked on the planning of Haifa and Tel Aviv in the early 1920s, the results were a serious compromise of the Garden City ideal. Eventually the lot sizes proved too large for a single urban house and too small for an apartment building. On the influx of radical Eastern Europeans, see Michael Levin, White City: International Style Architecture in Israel (Tel Aviv: Tel Aviv Museum, 1984), and Gilbert Herbert and Silvina Sosnovsky, Bauhaus on the Carmel: The Coming of Modern Architecture to Hadar HaCarmel, Haifa, no. 8 (Haifa: Technion, 1985). The chief city planner for the first twenty years of the kibbutz movement was a German architect, Richard Kaufmann, who had studied in Munich under Theodor Fischer in the same class with Erich Mendelsohn. Kaufmann's connection to the German Garden Cities movement was well established before his emigration to Palestine, and in 1921–22 he traveled with the director of the Jewish Agency to Essen to observe the new town settlements serving the Krupp factories.
57. Joseph Blasi, The Communal Experience of the Kibbutz (New Brunswick, N.J.: Transaction Books, 1986). As of 1979 there were 270 kibbutzim with a total population of 120,000, or 3.66 percent of the population.


64. Fishman, *Urban Utopias*, pp. 122–55, cites Wright’s opinion of cities: “To look at the plan of any great city is to look at the cross-section of some fibrous tumor.” His categories of housing in Broadacre City were based on the number of automobiles one owned, from one to five.


78. Ibid., p. 39.

79. Don Canty, “Sea Ranch,” *Progressive Architecture*, February 1993, pp. 84–92. The initial planning concept of Sea Ranch degenerated a few years after and is criticized by the original protagonists as “suburbanization.”


82. Barry Commoner, “Ending the War against the Earth,” *Nation*, April 30, 1990, p. 589. This has been at the cost of over one trillion dollars.

83. Bramwell, *Ecology*, 195–208, reveals that the Nazis were the first radical environmentalists to achieve political authority at the state level. Somehow the world is still not ready to accept that Dachau was not only the site of a notorious death camp but also of an experimental organic farm, and ecologists will doubtlessly feel squeamish about this historical prece-
dent. Rudolf Hess, Hitler’s deputy, and Walther Darré, the minister of agriculture, helped establish two thousand biodynamic farms, based on the organic principles of Rudolph Steiner. Nazi Germany was also the first European country to establish nature reserves. Nazi slogans such as “Blood and soil” and “A new era is upon us which will be the era of the peasant” made a tight fit with ecology. That both Hitler and Himmler were vegetarians and believed in animal rights also created a natural affinity.


