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RETURNING TO ECOLOGY: AN ECOSYSTEM APPROACH TO UNDERSTANDING THE CITY

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Editor's Comments:

Essays by McKenzie and Burgess consistently return to the central ecological metaphor of the Chicago School. In the following extracts, they draw strongly on lessons of plant ecology (including notions of invasion, succession, etc.) to account for the growth of urban communities. In this chapter, Vasishth and Sloane reconsider human ecology, and discover merit in a scale-sensitive 'ecosystem approach' to understanding and planning the city. From a stout defense of the Chicago School's legacy, they argue that fundamental categories (such as organism, population, and community) retain their significance. In addition, the ecosystem approach retains the emphasis on place, and this brings back the environment into consideration.

Chicago Quotes:

In the process of community growth there is a development from the simple to the complex, from the general to the specialized; first to increasing centralization and later to a decentralization process. In the small town or village the primary universal needs are satisfied by a few general stores and a few simple institutions such as church, school, and home. As the community increases in size specialization takes place both in the type of service provided and in the location of the place of service. The sequence of development may be somewhat as follows: first the grocery store, sometimes carrying a few of the more staple dry goods, then the restaurant, poolroom, barber shop, drug store, dry-goods store, and later bank, haberdashery, millinery, and other specialized lines of service.

The axial or skeletal structure of a community is determined by the course of the first routes of travel and traffic…The point of junction or crossing of two main highways, as a rule, serves as the initial center of the community.

As the community grows there is not merely a multiplication of houses and roads but a process of differentiation and segregation takes place as well. Residences and institutions spread out I centrifugal fashion from the central point of the community, while business concentrates more and more around the spot of highest land values. Each cyclic increase of population is accompanied by greater differentiation in both service and location. There is a struggle among utilities for the vantage-points of position. This makes for increasing value of land and increasing height of buildings at the geographic center of the community. As competition for advantageous sites becomes keener with the growth of population, the first and economically weaker types of utilities are forced out to less accessible and lower-priced areas. By the time the community has reached a population of about ten or twelve thousand, a fairly well-differentiated structure is attained. (73-74)

…The structural growth of community takes place in successional sequence not unlike the successional stages in the development of the plant formation….And just as in plant communities successions are the products of invasion, so also in the human community the formations, segregations, and associations that appear constitute the outcome of a series of invasions. (74)

…The general effect of the continuous processes of invasions and accommodations is to give to the developed community well-defined areas, each having its own peculiar selective and cultural

characteristics. Such units of communal life may be termed "natural areas," or formations, to use the term of the plant ecologist…It has been suggested that these natural areas or formations may be defined in terms of land values, the point of highest land value representing the center or head of the formation (not necessarily the geographic center but the economic or cultural center), while the points of lowest land value represent the periphery of the formation or boundary line between two adjacent formations. (77-78)

…community life, as conditioned by the distribution of individuals and institutions over an area, has at least three quite different aspects.

First of all, there is the community viewed almost exclusively in terms of location and movement (144) …This apparently "natural" organization of the human community, so similar in the formation of plant and animal communities, may be called the "ecological community." (145)

…In the second place, the community may be conceived in terms of the effects of communal life in a given area upon the formation or the maintenance of a local culture. Local culture includes those sentiments, forms of conduct, attachments, and ceremonies which are characteristic of a locality, which have either originated in the area or have become identified with it. This aspect of local life may be called "the cultural community." (145)

…There remains a third standpoint from which the relation of a local area to group life may be stated. In what ways and to what extent does the fact of common residence in a locality compel or invite its inhabitants to act together?…This is the community of the community organization worker and of the politician, and may be described as "the political community." (146)

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Rethinking Rain In LA

When people think of rain, they don't think of sunny Southern California, and if they do, they're only remembering the most recent drought. Because the amount of rainfall is foremost in people's minds in a drought-prone region, related issues like storms receive relatively short shrift in urban policy and planning. However, as with many ecological processes, the particulars make a difference. On average, about half of Southern California's total annual precipitation is concentrated in a handful of storms that occur during a couple of months.[1] Because of this disproportionate intensity in downpour, issues related to urban storm water drains and beach debris provide a simple example of the need to rethink urban environmental planning in a way that recognizes the functional scales of natural processes.

The City of Los Angeles, along with most of the cities in Los Angeles County, has an extensive system of storm water drains which run directly into the ocean without any pretreatment. For most of the year, these drains are dry and trash from city streets accumulates in them. When the rains come, tons of trash are carried out to the ocean, tidal action returning between 50 to 75% of this garbage to coastal beaches. Well over half of all debris found on Southern California's beaches may have originated in inland cities and towns.[2]

Under conventional public planning and policy decision making structures, "local" concerns are prioritized over "global" concerns. At each level of decision-making — city, county, state, nation — administrative units treat their boundaries as natural delimiters of responsibility. However, the difference between what is "local" and "global" is not always obvious. If, for instance, the city decided for budgetary reasons to cut back the number of downtown trash cans and the frequency of trash collection and street cleaning operations,[3] this "local" decision might save the city's taxpayers money and have only a marginal impact on the appearance of downtown Los Angeles. From an ecological standpoint, though, the cutbacks would quickly increase the amount of trash deposited on the beaches of Santa Monica bay. The City of Santa Monica would, then, be forced to either increase its beach sanitation expenditures or abrogate its civic responsibility. From such an ecological view, which may require us to draw quite different boundaries, what does it mean to speak of "the city"?

A different response to such environmental and community issues might be to take an ecosystem approach to decision-making in urban planning and policy. Then, “the city” could be seen as a conceptual label given to layered, overlapped and nested arrangements of sub-systems, systems, and supra-systems organized in scale-hierarchic rather than rank-hierarchic arrangements. We would better treat the patterns we observe in “the city” as tangible but abstract representations of intangible but actual processes and functions. Once urban planners and policy makers begin to take such an ecosystem approach, words such as “local” and “global” are transformed. They are no longer robust natural categories, but simply stereotypes providing first approximations, awaiting refinement and the insertion of functional and perspectival meaning.

Yet, making such a transition requires confronting three-quarters of a century of social theory-building. The early direction of this enterprise was set by founders of the Chicago School of Sociology, who derived their urban theory from their conceptions of science and nature, particularly ecology and evolution. Robert E. Park, Ernest W. Burgess, and Roderick D. McKenzie adopted the then-current vegetation ecology model of population dynamics and successional change in plant communities proposed by Frederick Clements to draw a theory of urban organization and change. They also used work from animal ecology and cell physiology to understand the role of competition and cooperation as mechanisms for evolutionary change and progress. These examples became the foundation for their subsequent efforts to empirically measure and map urban patterns and processes, and more generally, to ecologize the study of society.[4]

Many conventional critiques of the Chicago sociologists ignore the historical moment of their activity, and so underrate the transformative aspects of their ecological leanings. As ecologists have moved beyond these primitive, prototypical models of natural organization and occurrence to develop more sophisticated notions of ecosystem dynamics which take account of patchiness and perturbation,[5] the shortcomings and errors embedded in those early models become easy to detect. More recently, neo-marxist and postmodern theorists have suggested that “the city” — through a globalizing economy and post-Fordist production — has so radically transformed from turn of the century cities that the Chicago model caricatured, that “the concentric circles model,” has lost both descriptive and explanatory power and must be completely replaced.

Yet a closer examination of the writings of Burgess, Park, and McKenzie, suggests that

contemporary efforts to understand urban social systems might benefit more by building upon the work of these early Chicago sociologists than by rejecting it entirely. Therefore, we suggest that the turn to ecology initiated by the Chicago urban theorists still provides a sound foundation for urban research.[6] Discarding the confounding effects of the then prevalent organismic frame and the notion of progress as ceaseless improvement, and introducing a natural organization and occurrence approach from ecosystem ecology, we argue that the scale-hierarchic ecosystem concept provides a rich and versatile frame for urban inquiry. Moreover, such an ecosystem approach, by centralizing historic, purposive, and perspectival contingency makes room for subjective as well as objective modes of knowing.

The Chicago School And The City

The Chicago School of Sociology prior to World War II represents the first institutionalized and systematic effort to take an ecological approach to social theory, and to look for ways to study community as an emergent entity. Their work represents a turning point in the place of cities, communities, urban phenomena and social facts as distinct from social analysis as special objects of study in social theory. Park, Burgess, McKenzie, and other early human ecologists are conventionally credited with institutionalizing, if not establishing, sociology as a science. They are also criticized for their overly empiricist and idealized approach to the study of society. Yet, the temper of their time and the momentum of ideas which enabled their work in the first place was such that both the institutionalization and empiricization were, perhaps, inevitable.

Social theorists Emile Durkheim, Ferdinand Toennies, and Georg Simmel centrally informed the Chicago School sociologists, as they did turn of the century Americans.[7] They took from John Dewey and Herbert Mead the principle that social research be directed by a concern for effecting improvement in prevailing social conditions.[8] And in particular, Albion Small played no small role in shaping the direction and research of Chicago's Department of Sociology.[9] He pushed systematically for an empirical, research-driven social theory instead of the armchair theorizing that had become so typical in the U.S.[10] and made a concerted effort to incorporate the work of European theorists into the curriculum.[11] Small was instrumental in sociology's shift away from the study of patterns toward the analysis of processes.[12]

Finally, the Chicago schools of pragmatism and sociology were influenced by the city of

Chicago itself. In it, the Chicago social scientists saw patterns of rapid and dynamic growth driven by migration and their recognition of migration as a formative pressure on patterns of urbanization conditioned the tools they crafted, the techniques they developed, and the concepts they evoked in their models. The particulars of urban change — the waves of immigrants, arriving, concentrating, and dispersing in patterned succession — and of ecological processes — invasion, assimilation, adaptation, cooperation, competition, and local migration — shaped their theoretical structures and the questions they asked in their research.

Ecology And Social Theory

Three dialectical histories of ideas in social thought converge to give direction, shape, and meaning to the work of the Chicago sociologists: ideas about the relationship between individual and community, or entity and environment; the nature and meaning of progress, equilibrium and climax; and the relationship between pattern and process, structure and function, organization and occurrence. These three themes have quite centrally shaped and polarized debates in social theory.[13]

From, at least, Auguste Comte's efforts in the mid-1850s to articulate a positive methodology, and Herbert Spencer's efforts to lay out a more prescriptive sociology of structure and function, conceptions in social theory have been grounded firmly in ideas about individual organisms — particularly as they affect assumptions about progress, equilibrium, and climax.[14] Both social theorists and scientists of nature have persistently projected characteristics of individual organisms onto community and society by the use of organismic analogies.[15] But, much as this organicism may have helped explorations of organization by providing the reductionist tools necessary for inquiry, it obscured at least some of what could be known, even then, about natural occurrence.

Although knowledge of humans and organisms has always informed our understanding of nature, this organicism becomes more problematic with the turn-of-the-century transition from a population to a community view. Levine[16] suggests that although Durkheim was opposed to the use of organismic analogy to understand community, his refinements of to the understanding of patterns and processes in society rest on ideas of a self-maintaining social organism. Clements' efforts to organize ideas about successional change in vegetative communities is also schematically driven by

the idea of community as super-organism.[17] And at least some of the critiques of Chicago sociology in planning might more accurately be leveled at the limitations of organicism in explaining community.

Individual And Community

Views of the relationship between individuals and community reveal a deep-rooted division in social theory. Is community (society) knowable as an additive agglomeration of individuals and events, or is community (society) a thing apart, always more that any aggregation of individuals? Can we sufficiently explain group interactions by examining the individuals that comprise a group, or, as Durkheim had it, are individuals themselves the products of community? If community is no more than some summing of its individual members, then data on individuals will explain community. More importantly for urban studies, community-level patterns can be used to map individual-level processes. But if community is more than merely the sum of its individual members, then community must be described at its own level of organization. This way, we can see community level patterns and processes as distinct from patterns and processes in populations of individuals.

In tracing the use of spatial metaphors in social theory, Silber[18] points to Durkheim's "attention to the 'external,' constraining reality of social facts, the boundedness of social wholes, the statistical distribution and density of social phenomena within the territory of the nation-state, and, perhaps best known, the ritual enforcement of physical and other boundaries between sacred and profane." Following from the work social of theorists like Simmel, Durkheim and Toennies, an increasing acceptance of such an environmental, contextual frame accompanies the emergence of a community view of natural organization.

Organicism And Evolution

The confounding influence of organicism on evolutionary thought rests on the assumption that the process of change in individual organisms is, generally speaking, a good thing. This assumption is based, for example, on the idea that an organism's ability to maintain a fairly constant internal state in the face of environmental stress produces equilibrium in nature. The life-cycle of an organism, from embryo to infant to youth to maturity to death and decay, therefore, becomes a plausible model for successional change in levels of organization other than the individual.[19] And the improvements apparent in the human condition, the increases in knowledge and technology and cultural refinement

so evident over the life span of even a single generation, reinforce the idea of evolutionary progress as increasing improvement. But deep and persistent divisions pervade discussions of equilibrium, progress, and succession, and are particularly relevant in the context of the Chicago urban sociologists, and the ways in which these ideas are incorporated in their models of urban patterns and processes.

From early on natural and social scientists accepted the idea that nature moves toward equilibrium in response to changing external conditions, and organismic metaphors were used extensively even in medieval times.[20] And Hippocrates, the Greek physician, pressed the idea of homeostasis in hypothesizing the tendency on the part of organisms and their organs to return to health after disruption or disease.[21] But it was only after theorist began to see the limits of this typological view that an individual or population view began to emerge and knowledge of organisms began to find application in generating explanatory and instrumental models which went beyond mere analogy. And it was only after this transition — associated as it was with the rise of a Darwinian model — that a concept of dynamic equilibrium and homeostasis was legitimized. Organismic conceptions of evolutionary change began to be applied in quite different ways to social theory, influencing the emergence of sociology as a science, in the work of Comte, Spencer, and Durkheim.[22]

From Types To Populations

Both Comte and Spencer began their efforts to formulate a science of society and social development from a conception of dynamic equilibrium, of the tendency toward harmony and balance and fit between organisms and their changing environment, where a "(f)ailure to maintain this harmony or balance — failure on the part of the organism either to modify its form in response to changes in the environment or (in the case of man) to modify the environment itself — would result in the death of the organism." [23] This is the property they then extend to society, seeing it as, itself, an organism:

> Life for the organism, as we have seen, depends on the maintenance of equilibrium between organism and environment — a maintenance achieved through the mutual interaction of organic functions. Similarly, the social organism maintained itself through interrelation among its constituent parts. As in healthy animal organisms no question could arise of conflict or competition among parts, so the tendency to cooperation rather than dissidence characterized the social organism as well.[24]

But while Comte and Spencer share this common ground,[25] their arguments develop in

opposition to one another,[26] and at least some of the tension between them derives from their different ideas of progress.[27] For Comte evolutionary progress was little more than a manifestation of a perpetually responsive adaptation by organisms to shifts in their environment, leaving a world that was, at any given moment, "as good as it could be." Spencer began similarly, by taking progress to be driven by adaptive responses, but instead, posited some final, ideal state toward which this progress was inexorably driven. For Spencer, evolutionary change was little more than a transitional phase, one that would terminate in a single, perfect ultimate state.[28]

But the subsequent Durkheimian project of transferring the organismic frame from individuals onto community and society,[29] remained problematic and limited in application until the emergence of some operational conception of group evolution. The work of botanists and plant geographers provided just such a conception, marked in most accounts, by Eugenius Warming's efforts to systematize knowledge of plant communities and of the patterns and processes of "communal life." In 1866, Ernst Haeckel coined the word ecology, and it was this later body of work synthesizing the organismic conceptions of community with the conceptions of landscape by geographers which gave shape and substance to ecology as a science.[30]

From Population To Community

This transition from a population view of nature to a community view marks the start of the ecological moment, even though preconceptions of organismic behavior and development remain entrenched and buried deep in early conceptions of community. And it is the turn-of-the-century work of plant ecologists and plant geographers such as Henry C. Cowles[31] and Frederick E. Clements,[32] following from Warming's operational outline in 1895 of the ecology of plant communities, that generated many of the instrumental sociological conceptions of community organization and occurrence. Ironically, these ideas of "developmental succession" and of "climax states," which themselves derived from early organismic social theories,[33] reinforced the applications of an organismic frame in the study of community — even as they allowed theorists and scientists alike to transcend the population view of nature.

But it was Frederick Clements' conception of community as a superorganism, and of monoclimax — the development of communities in a fixed pattern of successional stages from inception through to some single ultimate climax state — that provides the keystone for the empirical,

though admittedly organismic, study of both ecological and social community. As Golley points out:

> Clements' concept of the vegetation as a superorganism is appealing since we can readily develop the analogy from our personal knowledge of individuals . . . . The (vegetative) formation "arises, grows, matures, and dies." Thus, the community and formation have unique emergent properties which are greater than the sum of the properties of the parts.[34]

Although Clements' postulation of vegetative patterns and processes proved central to the enterprise of both ecology and social theory, his theory of successional development was intended more as an idealized frame for structuring inquiry than as any product of systematic observation. Within ecology, his ideas of succession toward a climatically determined monoclimax were quickly challenged,[35] but never quite displaced until the more recent transition in ecology to an ecosystem view.[36]

Clements' Spencerian conception of nature was formatively influenced both by his own experience of the pioneering settlement of the North American prairie by white Europeans, and also quite explicitly by Frederick Jackson Turner's 1893 account of the evolutionary life history of frontier society.[37]

> In a 1935 essay, for example, (Clements) explicitly compared the development of vegetation with the pattern of settlement on the frontier of the Middle West. The progression of plants in a habitat follows a process or pioneering and settlement, just as man's advance was doing on the prairie. The stages of civilization formed their own kind of sere: first trapper, then hunter, pioneer, homesteader, and finally urbanite.[38]

It is admixtures of these core conceptions — of community as superorganism, of orderly successional stages of development toward some preferred or ideal state, of self-regulating equilibrium, of progress as improvement and civilization, of change as organismic and comparable to individual life histories, and the notions of association, interdependence, cooperation and pioneering invasion — that limit the sorts of tools conceptually available to the Chicago sociologists in developing an empirical science of society. And these forces, bound by the insights and prejudices of the time, mark the ecological moment of Chicago urban sociology in their transition from an individual to a community frame.

The Ecological Turn

A key driver in this ecological turn was an emerging awareness of the distinction between pattern and process. Both in the study of nature and of society, there was a growing recognition that the structures, forms, and patterns most apparent to direct observation were merely material

manifestations of underlying processes and functions. These processes and relationships were the true constitutive forces in nature and society, and thus the proper objects of inquiry, while the patterns they generated were indices that allowed one to "get at" the processes behind them, providing the tools by which to change nature and society.

The Burgess "zonal hypothesis" is likely the most widely known, and probably the most narrowly understood, concept of the Chicago urban sociologists. The fact of urban expansion was well recognized by the turn of the century, particularly in America, and the conception of "metropolitan areas" extending well beyond a city's political boundaries had already taken shape.[39] With the rise of urban planning as a discipline, particularly infrastructure planning, the desire to anticipate and direct these patterns of expansion generated questions about the processes of urban expansion. Based on extensive efforts to empirically measure processes and functions within the city of Chicago, and to map the patterns generated by these processes, Burgess sought to express an ecological pattern he saw emerging from their data, a pattern he believed to be as natural, inevitable and universal to city development as Clement's proposed pattern of successional development in plant communities.

Burgess proposes that this pattern of urban expansion took the form of functionally-differentiated zones, radiating spatially outward from the city's central business district. His diagram of four concentric circles illustrates his primary hypothesis about "the tendency of each inner zone to extend its area by the invasion of the next outer zone" (Burgess 1924 (1967:50)). What made these patterns ecological for the Chicago urban sociologists was their recognition that urban expansion was neither arbitrary nor haphazard but quite strongly controlled by community-level forces such as land values, zoning ordinances, landscape features, circulation corridors, and historical contingency. The patterns that emerged were ecological because they emerged not from chance or human intent but rather from the "natural" actions of "the selective, distributive, and accommodative forces of the environment" on the "spatial and temporal relations of human beings".[40] And what made their method of inquiry ecological was that they sought to derive patterns from a study of processes, rather than to ascribe processes to observed patterns. Their conception of urban development processes and the patterns they saw emerge, are strongly reminiscent of Clements' ideas of plant community development.[41]

In the years following presentation of the "concentric rings model," a number of studies

attempted to support or refute the model. However, many critiques of the zonal hypothesis erred in taking the ideogram of four concentric rings as a literal expression of spatial reality rather than seeing it as ecological. Davie,[42] for example, attempted to present "a concrete test of the validity of the Burgess hypothesis," drawing circles on half-mile units around cities and then seeing if those zones matched Burgess' ideogram. They didn't correspond. His failure to find correspondence between these spatial zones and the "cultural and functional boundaries" of social data, however, says little about the validity or failure of the Chicago model.[43] As McKenzie[44] reminds us: "Ecological distance is a measure of fluidity. It is a time-cost concept rather than a unit of space. It is measured by minutes and cents rather than by yards and miles. By time-cost measurement the distance from A to B may be farther than from B to A, provided B is upgrade from A." Under such a definition of "distance," everyday spatially-geometric concepts like circles and squares become abstractions rather than any literal depictions of reality.

Undoubtedly, the particular views of progress, nature, and monoclimactic end-states held by the Chicago urban theorists distorted their model, forcing them to interpret the city in certain ways. But the shape of their world view is a result of their understanding of the best science available to them, and they set in place a move *away from the pattern realism of entity and place, and toward the process actuality of function and scale*.

Returning To Ecology: Organization And Occurrence

The ecological turn produced by the Chicago sociologists sets the foundation for the development of an ecosystems approach to social theory and urban planning. In such places as Los Angeles, we can apply alternative conceptions of boundaries and scale that allow us to better and differently understand the relationship between issues that are now viewed separately in policy discussions. Default planning practice usually takes organization to be linear and rank ordered, boundaries to be inherent, and scales to be topographical and chronological. Thus we often represent intangible relationships and processes with "boxes and arrows" — boxes standing for the real and meaningful objects of concern and arrows symbolizing conceptual constructs.[45]

Ecosystem ecology, however, takes organization to be nested and overlapping, boundaries to be contingent with respect to purpose and perspective, and scale to be directly attached to

processes and functions.[46] In such an ecosystem approach, where systems are seen to be driven by relationships and processes, it is the arrows that are taken as the real and meaningful objects of concern, while the boxes represent conceptual constructs deriving from the particulars of our purpose and helping us to understand the functions and flows we properly care about.[47]

Within such an ecological conception of organization and occurrence, nature and society reflect multiple and simultaneous realities, since we know that the reality we see is contingent upon: (1) the perspective, purpose and point of view we elect to take; (2) the levels of organization we consider significant and within which we situate ourselves for observation; (3) the boundaries we choose and maintain or change during description; and (4) the scales by which we choose to give these descriptions.

Contingent Boundaries: Mugu Lagoon.

The case of Mugu lagoon in Ventura County, California, illustrates the problem of naming and choosing boundaries. Located at the southern end of the county coastline, this lagoon is one of the few remaining links in the Pacific flyway, providing vital resting, feeding and nesting habitat for a wide variety of migratory birds. Although its location inside the boundaries of a Naval Air base leave it, at present, well protected, the lagoon has historically been subjected to intense internal and external stresses and pressures, and a strong case has been made for its management.[48] It is a fascinating case, with quite distinct hydrologic, atmospheric, biologic, technologic, and administrative dimensions. And each area of concern brings with it its own functionally-derived set of boundaries.

To further complicate matters, none of these boundaries will stay put, whether due to perturbation and pulsing, to changing interactions between its biotic and abiotic subsystems, or to changes in land use or other regulatory regimes. In such cases, management efforts — particularly those aimed at either preserving the lagoon in some “natural” state, or conserving some “natural” functions — become particularly problematic, since the lagoon will not sit still. Tectonic activity is ceaselessly changing topographies in Southern California, and ocean levels themselves change over geologic time.[49] So, 2,000 years ago the present site of the lagoon was under the Pacific Ocean. Two hundred years ago it was a salt-water lagoon, with virtually no surface (fresh) water inputs. But with the growth of settlements in the late 1800s and flood control in adjoining basins and plains, run-off from surrounding areas was channeled into the lagoon, turning it into an estuarine (mixed salt and

fresh water) lagoon.

With the growth of agriculture, surface run-off began to change, both in terms of toxicity and turbidity (sedimentation). Although siltation has been increasing over time, turning more and more of the lagoon into wetlands and marsh, dredging to restore depth and throughflow may call for unacceptable tradeoffs since the layers of silt clogging the lagoon have trapped within and beneath them significant amounts of DDT and other pesticides from surrounding agricultural lands, as well as toxic chemicals from the naval base. Regional meteorological conditions and wind patterns, coupled with the atmospheric chemistry of oxides of nitrogen generated by air pollution in the Los Angeles and Ventura air basins have also taken their toll in the form of increased acid rain.

Rapid suburbanization as far as 50 miles inland, including Simi Valley and Thousand Oaks, has had its own impact. The increase in paved surfaces and roof areas, when combined with a pattern of infrequent but intense rainfall and a soil structure unable to absorb more than 4 inches of rainfall, has increased surface runoff throughout the extensive watershed and dramatically altered the physical parameters of the lagoon by increasing siltation rates.[50]

And nature, too, adds its own pressures. Over the past two decades, a two-week period of storms has completely altered its depth profiles, radically changing the mix of species the lagoon can support. And even now, tidal action, partially modified by the construction of breakwaters to protect beach-front properties a few miles north, is cutting a submarine canyon near the mouth of the lagoon, sucking the very coastline away from around it.[51]

Depending on what aspects we concern ourselves with, we find quite different sets and sorts of boundaries: the lagoon at low tide, the lagoon at high tide, the lagoon and its wetlands, the lagoon and its watershed, the lagoon and its catchment, the lagoon and its air basin, the lagoon and the Pacific flyway extending from Canada to South America, the lagoon and endangered species, the lagoon and adjacent land use, the lagoon and administrative agencies. Each of these boundaries varies considerably from all others, and none is inherently more useful (or even independently robust) for purposes of management. Efforts to treat the lagoon as a “place” with some inherent state that demands preservation or conservation, “naturalize” the lagoon in quite unnatural ways.

Functional Scales: Lead Paint.

Ecosystem ecology is concerned primarily with relationships and connections linked to processes and functions in natural systems, and only secondarily with the morphology of individuals, communities of organisms, events and landscapes. In urban environmental planning, such is the case with lead abatement. Lead is widely recognized as a highly toxic substance, with both acute and chronic health effects. Exposure leads to neurological and immune system damage, and often results in reproductive and developmental disorders.[52] And so, many cities have instituted intensive lead abatement programs. But the picture of lead in an urban setting is contingent upon whether we think of lead as a thing, attached to other things (such as electrodes on batteries, or paint on buildings), or whether we think of lead as constituted by processes and functions of exchange and transformation. For example, much of the effort in lead abatement programs has focused on (and often stops at) finding products with substantial lead content and removing or containing them — a morphological, point-source mitigation approach to lead abatement that does little to recognize how the presence of lead relates, functionally, to other processes.

But urban ecological studies begun in Baltimore and Minnesota during the 1980s tell a quite different story.[53] Recognizing that lead is a persistent substance that tends to accumulate in the soil, these studies use what atmospheric scientists call a lifetime-and-fate approach, shifting focus away from the physical and morphologic incidence and distribution of lead-containing objects, and toward the flows and concentrations of lead within the urban system over time. Once lead is physically released into an urban environment, much of it tends to accumulate in the soil. These ecological studies found little correspondence between the density distributions of lead-containing objects (such as old neighborhoods with painted wooden houses) and densities of lead in the soil. Instead, we can best describe long-term, accumulative densities of lead in urban areas in terms of atmospheric and geophysical processes.

At the scale of the building, for instance, lead concentrations are independent of whether the building were unpainted (brick) or painted (wood). Even around a building, lead will be disproportionately concentrated in soils on its upwind and road-facing sides. At the scale of the city, too, concentrations of lead in the soil are linked more closely to particulate behavior within thermal processes than to present-day patterns of emission, or to the incidence of buildings with lead-based paint. The studies found that lead accumulation in urban soils within a city corresponded most closely

to the presence of heat islands like high density downtowns (even those that never had any lead-based paint buildings), to atmospheric dust such as in areas with little erosion-controlling ground cover, or to high volumes of diesel-fueled vehicular traffic. Any concern with the health effects of lead in urban settings requires descriptions at multiple levels of organization, that use multiple scales derived from chemical, biological, geological, meteorological, industrial, and mechanical processes and functions.[54]

An Ecosystem Approach To Scale In Planning

Spatial scales will always be important to urban and environmental planning. Simply put, place matters. We are spatial creatures, and much of the business of our existence occurs in the tangible, morphologic, topographic world. Landscapes, organisms and entities are what we sense and interact with most directly, and so they allow us to manipulate the world. Besides, biotic and abiotic entities have physical form and take up space, and so natural and social community is contingent upon territorial organization.

However, ecosystem ecologists argue that organisms, entities and landscapes are most usefully treated as manifestations of not so obvious processes and functions — that is, exchanges of matter, energy and information — and that these processes and functions are the proper and fundamental ways that natural organization and occurrence should be conceptualized.[55] Ecosystem ecology begins with the premise that all systems, including ecosystems, are theoretical constructs rather than real “things,” and thus demand a much richer conception of scale. Scale has spatial, temporal, and organizational dimensions which are contingent upon the location of the observer ,can only be functionally derived and becomes meaningful only after we explain our purpose in choosing it.

Further, there are certain classes of things (problems, situations, phenomena, issues, social facts) that are fundamentally ecological in their organization and occurrence. Such ecological things are not “things in themselves,” singular entities with agreeable boundaries and reconcilable properties. Instead, they have no inherent boundaries, and exhibit multiple and pragmatically distinct levels of organization. Each level requires its own set of scales for description, and descriptions of patterns and processes at one level of organization may tell us little about organization or occurrence at another.

We must draw distinctions between problems that can be treated as closed systems and those that are most usefully viewed as open systems. In Rittel's[56] characterization, "tame" problems, however complicated, can always be solved, while "wicked" problems, conversely, show no logically starting point and no computable end. Rittel[57] formulates a series of "properties" for such wicked problems. They defy definitive description and can always be multiply described. Moreover, every formulation of such a problem may lead to a different solution. Models or predictions of future states, therefore, become contingent on problem formulation, as well as on what one imagines the original state to be. Wicked problems, as open systems, have no logical stopping point, no inherent end state that allows one to claim to have "solved" the problem. Nor, because of this, do they show any natural stage at which implemented solutions can definitively be tested for success or failure. Further, "every wicked problem can be considered a symptom of another problem."

Taking this to the scale-hierarchic approach in ecosystem ecology, where a phenomenon or circumstance at one level of integration may have functional connections with its supra- and sub-systems, what is taken to be a problem at one level may well be beneficial or even essential at another, and perhaps a whole different sort of problem at some other scale of description. Finally, for purpose of this discussion, every wicked problem is unique. This, taken along with the absence of clear starting and end points, means that the method of trial and error, which rests most on the building of experiential learning, becomes less reliable and must at least be relocated within the methodological repertoire for planning with open systems.[58]

Such ecological *things*, we argue, can only be usefully described by using an ecosystem approach. What sets such an ecosystem approach apart from past and conventional efforts at ecological description both in ecology and in urban planning-related social sciences are scale hierarchic description and an evolutionary frame. Ecology, and an ecosystem approach, importantly, shifts the focus of attention in planning.

Briefly, a scale hierarchic approach in ecology holds, first, that all ecological systems are conceptually bounded by the pragmatics of purpose, exhibiting distinct, functionally-nested levels of organization.[59] In ecology, for instance, individual, population, community, and ecosystem represent useful levels of organization. Each level of organization needs to be explicitly recognized in description, and each level of organization relevant to purpose may need to be described at more

than just one or two functional scales. These levels of organization are linked by (indeed constituted by) processes and functions, and each level of organization interacts with its sub- and supra-systems in very particular and variable ways. So there are rules we can discover by following processes and functions across levels of organization.

An ecological phenomenon requires description at more than one level of organization, with each level demanding its own set of particularized tools and scales, since observations of occurrence at one level of organization may have little to tell us about responses at other levels.[60] In an ecological view, the world, in its organization and its occurrence, appears differently at different levels of organization and at different scales of description, where what one can see of it is sometimes dramatically contingent on the boundaries chosen in the first place.

The core conception behind the ecosystem approach from process-function ecology is that of a nested, scale-hierarchic arrangement of complex, self-organizing set of systems and sub-systems nested within and around each other. Conceptually, any system of concern emerges from the relationships amongst its constitutive sub-systems, and relates responsively with other systems to comprise some wider supra-system. It is important to note that we know the complexity of any particular system by the quantity and quality of relationships it contains, rather than simply and trivially by the number of its components.

We suggest that such an ecological approach to description offers planning — particularly in nature management and community planning — useful tools for organizing and resolving apparent contradictions in analysis and assessment. The significance and difficulty of separating pattern from process, structure from function, organization from occurrence, and also the telling apart of ontogenic and phylogenic (individual and group) evolutionary processes, is likely to be large.[61] Space, whether geographic, administrative or temporal, becomes a necessary but insufficient measure for telling the differences between structures and functions. While there are, undoubtedly, meaningful structures to be identified in describing social and natural phenomena, these structures take more of their shape from processual relationships than from simple sequences and proximities. Even when we do find and bound such structures, and find them to be durable over time, we can never take for granted their circumstantial and perspectival contingency.

A pragmatic approach to planning no doubt requires that we make models of the world. But

these models are intentional and provisional, and the structures and functions we ascribe to the world for any particular purpose — the boxes and arrows we draw upon it — are always contingent and open to revision.[62] When we are dealing with open systems that defy agreeable reduction, the descriptions we make require particular attention and demand at least the explicit testing of spatial, administrative and temporal scales.

A central challenge in an ecosystem approach to planning and its concern with managing open systems, lies in this seeking out and questioning traditionally accepted definitions in our conceptions of organization, boundaries and scale — definitions which, in the absence of careful attention, inevitably permeate the descriptions we make of the natural and social world we seek to control. In such cases, the idea that we should “think globally, act locally” becomes less than adequate, and we may need to settle for some less catchy but more pragmatic version — perhaps one that says: think at the scales that matter, and act at the levels that count.

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End Notes

1. Onuf, 1987.

2. Bierce and Debenham, 1990.

3. Rainey, 1993.

4. Park et al., 1925, 1967.

5. Odum, 1969; Pickett and McDonnell, 1989; Pickett, 1985.

6. Quinn, 1940; Duncan, 1961; Catton, 1993, 1994; and Smith, 1995.

7. Kurtz, 1984, p. 17.

8. Kurtz, 1984, p. 8.

9. Russett, 1966, pp. 61-74; Kurtz, 1984:93.

10. Faris cites Lester F. Ward. William G. Sumner, Franklin H. Giddings, and Edward A. Ross amongst those American pioneers who "had a strong disposition to discover, mainly by reflection, one or a few fundamental and simple principles that would serve as explanation of all human behavior." (Faris 1970, p. 4)

11. Kurtz 1984, p. 17, outlines this influence, pointing out that "European social thought figured prominently in their teaching and research, and in articles by Simmel, Toennies, and Durkheim translated and published in the early issues of the (American Journal of Sociology, which was then largely controlled by the Chicago sociologists). Simmel's influence was pronounced in early American sociology, thanks largely to Small's efforts. Small was at the University of Berlin while Simmel was himself a student there..."

    Further, Faris (1970:108) argues that Park, who had studied under Simmel while traveling in Europe, received from him the concept of social distance, and that Park later "suggested to Bogardus that the latter devise a social-distance scale as a statistical basis for the life-history materials in this field."

12. Russett, 1966, p. 67.

13. Russett, 1966; Davison, 1983; Mitman, 1992; Cittadino, 1993; Levine, 1995; Silber, 1995.

14. Russett, 1966.

15. Levine, 1995.

16. Levin, 1995, p. 254.

17. Although Clement's (1916) notions of successional stages culminating in some climatically determined mono-climax were quickly challenged and problematized within ecology (Gleason, 1917; Tansley 1935), "...the concept became a central tenet of range condition analysis used by the USDA for range management...and is still used today even though it is recognized as conceptually flawed..." (Gibson 1996).

18. Sibler, 1995, p. 329.

19. Gould, 1977.

20. Berlin, 1965, pp. 50-51.

21. Russett, 1966. p. 19.

22. Russett, 1966; Levine, 1995.

23. Russett 1966, p. 30. The claim that the ability to modify the environment as an adaptive strategy is unique to humans rests on a rather narrow definition of what it means to modify the environment. The work of James Lovelock and Lynn Margulis (1974) supports a recognition that all biotic entities and some abiotic processes do indeed modify their environment by the very activities of their own existence.

24. Russett, 1966, p. 33.

25. Russett (1966:28) points out that the two men, though contemporaries, never met each other.

26. Russett (1966:28-) shows some of the oppositional consequences of Comte's background in mathematics and adoption of biological knowledge, and Spencer's background in engineering and adoption of the knowledge of mechanics.

27. Berlin (1965:82) argues that the notion of a steady progress, at least in human history, was one of three well established myths of the eighteenth century — the other two being the myth of one culture's innate superiority over others, and the myth of a classic, sunlit culture of the past (whether Gallo-Roman or pagan). But it was not until a century later that knowledge of life and evolution grew to a stage where the idea of progress begins to affect organismic conceptions.

28. Interestingly, Hull (1988:27), in problematizing the conventional history of ideas about progress, one that dominated until fairly recently, says: *According to the traditional view, no one throughout human history found the idea of progress either in nature or in the course of human affairs plausible or appealing until the Renaissance. The ancient Greeks and later Romans viewed the world in terms of eternal cycles, while Christian theology portrayed human history as a period of tribulation between Adam's fall and the Second Coming. Not until the sixteenth century did intellectuals in the West begin to think that possibly human history as well as nature at large might be progressive...*

    While Hull proceeds to formulate an alternative history, these two positions can perhaps be taken as representative of some broad division in social thought. Certainly the versions of evolution and progress elaborated by Comte and Spencer appear generally to divide along similar lines.

29. Durkheim, 1898 and 1974.

30. Worster, 1977, p. 198; Allen & Hoekstra, 1992, p.130.

31. Cowles, 1899.

32. Clements, 1916.

33. The notion of succession as an orderly and repeating pattern of social change, akin to the life-cycles of organisms, was used in social theory before it appeared in ecology. The phrase "sociological succession," to denote some version of orderly displacement in social groupings, was used at least as early as Comte. In ecology, the term "plant sociology" was used almost interchangeably with plant ecology at least until the 1950s (Whittaker 1953). More generally, the term sociology was commonly used to "designate the study of patterned associations among and between different non-human species of organisms" (Catton 1993:74)

34. Golley, 1977, p. 181.

35. Gleason, 1917, 1926; Tansley, 1935.

36. See Odum 1960 and 1969. For a comprehensive review of the early ecological literature on succession and climax theories, both in the US and Europe, see Whittaker (1953).

37. While the influence of Turner's frontier hypothesis and of the pioneering settlement process shows quite clearly in Clements work, there were surely other forces that may have been as formative. After all, Warming, who lived and worked in Copenhagen, appears to have outlined a theory of successional development that can reasonably be seen as precedent to Clement's version. Certainly Clements was not working *tabula rasa*, but participating in a more painstaking process of knowledge building. And certainly the frontier hypothesis would have at least reinforced already, and differently, emerging understandings of nature and society. But there may have been no great leap in insight, no singular "paradigm-shift," rather a patchy and sporadic transformation of ideas and conceptions as diverse ways of knowing came together and went their own ways.

38. Worster, 1977, pp. 218-219.

39. Burgess, 1924, 1967, pp, 48-50.

40. McKenzie, 1924, 1968, p. 63.

41. For all that Clement's conception of community as super-organism was a prerequisite for the Chicago urban theorists efforts to find a scientific basis for sociology, the range of sources they drew from were considerably richer.

42. Davie, 1937.

43. Quinn, 1940.

44. McKenzie, 1926, 1968, p. 22.

45. Verma, 1993.

46. Allen and Starr, 1982; O'Neill, et. al., 1986; Allen and Hoekstra, 1992.

47. Verma (1993) argues that this is the "savvy" version of any systems approach.

48. Onuf, 1987; SCS, 1994.

49. Onuf, 1987.

50. Williams, 1993.

51. Weiss, 1994.

52. Winder, 1993; Folinsbee, 1993; Goyer, 1993.

53. Mielke, 1994.

54. Cernak and Thompson, 1977; Mielke, 1994.

55. O'Neill, et al., 1986; Allen and Hoekstra, 1992.

56. Rittel, 1972.

57. Rittel, 1972, pp. 392-394.

58. Holling and Goldberg, 1971; Holling, 1986.

59. Functional nesting is not necessarily analogous to, and certainly not commensurate with, morphological or spatial nesting (e.g., the “boxes within boxes” model). In fact, getting at processes and functions directly, both in ecology and social theory, is made imperative because functions (processes) don’t map reliably from structures (patterns).

60. Checkland, 1981.

61. Levin (1992), has argued that this matter of telling pattern from process remains as the challenge for ecosystem ecologists.

62. Krieger, 1989.