Human Ecology

Persistence and Change

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In their search for order in the turbulent urban centers of America in the early years of the present century, sociologists were stimulated by work then being done by bioecologists on the structure and development of plant associations. Those researchers showed that plant species adapt to their environment by distributing themselves over a localized area in a pattern which enables them to engage in complementary uses of habitat resources. That idea opened a vista to an understanding of what was occurring in the burgeoning industrial city. For then it was apparent that various subpopulations were jostling for spatial positions from which they could perform their diverse functions in an unfolding division of labor. There followed numerous field investigations addressed to the proposition that components of the urban community were systematically arranged in space. Accordingly, human ecology became identified with the study of urban structure, particularly in its spatial aspects.

But ecology also embodies a theoretical perspective with implications that reach well beyond a particular class of phenomena. It invites a host of questions about the relation of population to environment; the character of the interactions among subpopulations, or species; about the structures of relationships that arise from those interactions; and about the developmental process itself. These several questions come to a focus in a unit of study termed the ecosystem, the structure of relationship within a population and between the population and its environment. In its study of the human ecosystem, human ecology has sought, turned away from, and resumed once again a liaison with bioecology. Of that more will be said in later paragraphs.

Thus human ecology has developed along two distinguishable, though not unrelated, lines of investigation. One has dealt with the form and development of urban organization, the other with how human social systems of whatever kind develop in different environmental

AMERICAN BEHAVIORAL SCIENTIST, Vol. 24 No. 3, January February 1981 423-444

settings. The first of these may properly be regarded as a special case of the latter, more general problem. While logically the expected procedure would have been to work from the general to the more specific question, historically human ecologists developed their subject in the reverse order. A consequence is failure to achieve full integration of the two approaches.

Both the urban and the general system problems, however, share what is commonly called a macro-level approach. That is, they have phrased their hypotheses in terms of structural properties of environments, population and organizations rather than in terms of attitudes, purposes, and preferences of individuals. This unfortunately fostered in some quarters a categorization of events as subsocial, or natural, and social, instead of being recognized as differences in ways of stating a problem. Actually, of course, there is no necessary opposition between macro and micro levels of analysis so long as both confine their subject matters to overt actions. The error arises when the psychological assumptions involved in studies of individuals are projected upon organizations.

The central position given to population rather than to the individual has established a close affinity of human ecology with demography. The point of contact lies at the interface of the mathematical properties of population and ecosystem structure. Thus the population of interest to human ecology is not the aggregate of all units conforming to a given definition but the aggregate of units which are subject to inclusion in a given system of relationships, that is, the aggregate which possesses or is in process of acquiring unit character. A demographic aggregate may be regarded as operating in a systematic way through the operation of birth and death rates on age and sex composition as expressed in stable population theory. That, however, assumes an integrity which is not intrinsic to the aggregate as such. Unit character is acquired rather as members of the aggregate relate their diverse activities to those of one another and thereby gain the ability to respond as a unit to environmental variations. Accordingly, human ecology finds its necessary to pursue the meaning of population well beyond the conventional denotation of demography. The full import of demographic parameters for an ecosystem has not yet been demonstrated.

In the following I shall consider first the major current issues in theory and research concerning urban phenomena and then take up the more general problems presently occupying ecologists. Unfortunately, the volume of activity in the field has been such that only the most salient events can be considered here. Moreover, limitations of space are such that it will also be impossible to pursue in depth many of the technical developments in recent works.

THE URBAN COMMUNITY

THE SPATIAL PATTERN

The Burgess (1925) concentric zone conception has exhibited a remarkable persistence. The only significant departure from the model was Hoyt's (1939) early modification which called attention to occasional radial land use sectors overlaying zones. The survival of the Burgess concept is not due to researchers having deserted the subject. Indeed, improvements in data sources and data-processing equipment have enabled scholars to revisit the concentric zone cum sector pattern with larger samples and more sophisticated analytical techniques than were formerly available (Anderson, 1961; Guest, 1969, 1972; Hunter, 1971; Haggerty, 1971; Hawkes, 1973). Although the several studies have called attention to minor deviation from and needed refinements in the pattern, they have confirmed that the distribution of housing types and of the occupational, educational, and family characteristics of city residents exhibit a gradient pattern of variation from low to higher values with distance from the central business district. That is a finding of some interest, for it suggests that the assumptions underlying the model are as pertinent in the third quarter as in the first quarter of the century. One might have expected that the great changes in transportation and communication which have occurred during the past 50 years would have so altered the determinants of accessibility that a different pattern would have emerged or, alternatively, that the model is now applicable only on a larger territorial scale. Haggerty's study is alone in noting pattern differences among the eight cities he studied. Having found that not all cities develop toward a standard morphology, he fails to offer an alternative proposition based on his finding that old cities show the expected pattern and new ones depart from it.

The revival of interest in the urban spatial pattern has led to a resurrection of the "natural area" concept, though under the rubric "segregation." No doubt the careful analysis and clarification of segregation indexes by the Duncans (1955), together with the growth of civil rights activity, stimulated much of the recent segregation research. The index of dissimilarity of distribution and changes of distribution over census tracts has been applied not only to race (Duncan, 1957; Taeuber, 1965) but also to ethnicity (Lieberson, 1961), religious affiliation (Duncan, 1959), education (Schnore, 1966), and occupation (Duncan, 1955; Uyeki, 1964; Fine, 1971). In view of the generality of the segregation propensity across characteristics, it is highly probable that an explanation cast in terms of prejudice alone is insufficient. In fact, there is accumulating evidence that socioeconomic effects operate independent of racial effects in producing segregation (Marsten, 1969; Taeuber, 1965: 180-183; Erbs, 1975; Farley, 1977; Wilson, 1978).

While the tendency for like types of people to cluster in homogeneous residential enclaves, that is, to segregate themselves, is observable in all socioeconomic levels, its import appears to vary with position on the socioeconomic scale. At the lower levels, residents rely upon local facilities for a large part of their formal and informal activity (Caplovitz, 1963). In higher levels there is little correspondence between residential vicinage and the territorial spread of voluntary group and institutional involvements (Scaff, 1952; Reimer, 1957; Hunter, 1975). The neighborhood may have meaning as a social unit mainly for the poor and disadvantaged members of an urban population (Kasarda, 1974).

The multidimensionality of residential clusterings gained an earlier recognition in what was called "social area analysis" (Shevky, 1955), which combined indexes of socioeconomic status, urbanity, and ethnicity to arrive at a stratification of areal units. It was but a short step from the three indexes to a larger scale groping through numerous data files with the aid of factor analysis in search of indexes on which to base a classificatory scheme. The technique, christened somewhere along the way as "factorial ecology" (see Berry, 1971), has attracted a great many practitioners. Although "social area analysis" and "factorial ecology" rely upon spatially distributed data, there has been no satisfactory demonstration that social areas have any counterparts in two-dimensional space.

Spatial analysis has encouraged an exhibition of methodological virtuosity but with little or no effect on theoretical imagination. Had it been otherwise historical investigations which have disclosed direct rather than inverse socioeconomic gradients (Conzen, 1975; Schnore, 1969; Lotchlin, 1972) and a lack of social class segregation (Warner, 1969; Schnore, 1969; Chaducoff, 1972) in 19th century city data would not have been allowed to stand as evidence contradicting 20th century location determinants. More important, however, the preoccupation with socioeconomic stratification offers no more than a partial contribution to an understanding of the urban community as a functioning system.

POPULATION DENSITY

The distribution of population in the urban place may be treated more abstractly as density or number of people per unit of area. A voluminous research literature has accumulated around the question of the meaning of density for a community. But virtually all of that literature deals with the effect on the individual's well-being of number of people per unit of territory. The results from multivariate analyses have been consistently negative; density has little or no effect when other variables, particularly socioeconomic status, are controlled (Galle, 1978). That has led to a shift of definition to persons per room in residential units, a definition which has yielded more positive results (Gove, 1979). But persons per room is density of quite a different kind, for it removes all privacy options available to persons per unit of territory.

From an ecological standpoint the important question concerns the effect of density for the functioning of the communal system. While that question has seldom been treated directly, it has often been investigated indirectly through the use of absolute rather than relative population size (Ogburn and Duncan, 1963; Kasarda, 1974). Mayhew and Levinger (1976) have approached the size effect more formally than is customary through the use of lattice theory to derive the expected number of interindividual contacts per population element. Their derivation introduces the element of time as a variable, a variable only gradually gaining the attention it deserves. Nolan's (1979) study of the sizes of governments shows a significant correlation with a surrogate for density of interaction, that is, the average distance among random pairs. Missing, however, are studies of the relation of density to the costs of transportation and communication.

THE GRAVITY MODEL

Residential density within the urban area varies on a gradient, as do many other indicators of functional properties. Gradients have been plotted for the distribution of amounts of land in residential, commercial, and industrial uses; for distances individuals travel to work and for services; for the origins of telephone calls; for newspaper subscribers; and for other indications of recurrent activities. Various measures have been used to describe the slopes of the gradients. Those include distance exponents, the Gini coefficient, the Zipf PP/D rule, and Stewart's "population potential" (Duncan, 1959). All of these are regarded as variations on a gravity model which assumes that the attractions of a center of activity diminishes systematically with distance. Stephan (1979) has translated the spatial terms of these descriptive formulations into temporal terms. Thus he has argued that a gravity model may be more usefully regarded as a time minimization model. The frictions of space, in other words, are experienced directly or indirectly as units of time expended.

That the human community, urban or other, may be viewed as an organization addressed to the economization of the uses of time was developed in some detail by Hawley (1950) and later elaborated in greater depth by Moore (1963). As these authors pointed out, the allocations of space to activities reflect their interrelations, their diverse tempos, and something of the manner in which their respective rhythms are coordinated. The ecological niche, or functional role, has a temporal as well as a spatial location. Melbin (1978) has employed this notion in his comparisons of urban night-time activities in cities with activities on former frontier lands. As a general rule it appears that the more multifarious the activities regularly engaged in, the greater is the attention given to time. This would seem to account for social class differences in temporal perspectives (O'Rand, 1974; Schwartz, 1978). It also enters into the subdivision of time in ever smaller units and their standardization over widening areas.

DOMINANCE AND THE URBAN HIERARCHY

The gradient distribution of community features is regarded as a manifestation of controlling influence exercised by administrative and other functional units concentrated at a center. Dominance, as that influence is called, attaches to those units which are most directly involved in mediating environmental interactions with a system and which therefore regulate the conditions essential to the functioning of all other units. While empirical treatments of dominance have usually employed data pertaining to economic functions, the dominance effect is also shared by cultural and other voluntary group functions and has been since the 19th century, as shown by Abrahamson and DuBick (1977; see also Lincoln, 1977).

But dominance proves not to be a simple mathematical function of distance. Rather, it is subdivided and partialed out, as it were, to the various members of a network of urban places. Different approaches have been brought to bear upon the system-of-cities concept. Of these the simplest is known as the rank-size rule, a probability theorem which holds that a city's size is a function of its ordinal rank in a city size distribution. Failure to find more than a partial confirmation of the rule has led to a substitution of a logarithmic transformation for a distribution of absolute sizes (Berry, 1961). That, too, yielded unconvincing results. The difficulty resides in the matter of boundary identification. In most cases a national territory, the entity commonly used, either overstates, as in developing nations, or understates, as in small, highly industrialized states, the actual universe of interdependence. Vapnarsky (1969) has used Latin American data to support his argument that both a high degree of regional closure and a fully developed interdependence among the urban places within the region are required for a rank-size symmetry.

A better systemic approach to a size-of-place distribution is based on functions performed. The hierarchy implied in that approach has been derived in two ways: one deductively as central place theory, the other inductively as an interaction network. Given assumptions of a predominantly commercial economy and a flat, uninterrupted terrain, the central place hypothesis describes a geometrically symmetrical distribution of cities of various sizes (Berry and Pred, 1961). The symmetry is lost, however, when the producing function gains ascendance in urban economies. For then access to extra-local resources and markets exerts greater locational influence than does access to local service clienteles. It is of interest to note in passing that number and spacing of central, secondary, and neighborhood business centers in the pre-1950 city provide the best fits to the central-place pattern (Berry, 1965).

Following an earlier study of dominance relations among cities in southern United States (Vance, 1954), Duncan and colleagues (1960) were able to describe the outline of a functional hierarchy among the 56 largest metropolitan areas of the United States using population size, value added by manufacturing, business services, wholesale sales, bank loans, and demand deposits as variables. The hierarchy derived in that study comprised 5 national metropolitan centers, 14 regional metropolises, 28 regional capitals and manufacturing centers, and 9 special cases which fall into none of the other categories. Although useful refinements of that hierarchy have been contributed by Pappenfort (1959), Winsborough (1960), Galle (1963), and Wanner (1977), the Duncan study remains as the single most comprehensive empirical demonstration of the existence of a functional hierarchy. One further thought has placed central place and functional hierarchic patterns in historic sequence. Mark and Schwirian (1967), using data for all incorporated places in Iowa, observed that central-place functions ceased to have a community-building effect as industrialization developed. Growth shifted to eccentrically located industrial centers and later to administrative or metropolitan centers.

The hypothesis of a hierarchical pattern in a system of cities appears to have been set aside for the time being, yet it is one of the more seminal ideas in the study of spatial patterns. But it has become apparent that the concept must be explored in a multiregional or multinational universe rather than in one area of regional scope. The multinational corporation seems to have been especially influential in knitting cities into a fabric of intercity relations (Hymer, 1975). The lack of suitable data in available sources, however, will continue to be a major obstacle to definitive work on a system of cities.

HIERARCHY AND THE DIVISION OF LABOR

An urban hierarchy is manifestly a functional system, that is, a territorial division of labor. The division-of-labor concept applies with equal logic to the internal organization of a system and to the territorial distribution of a system's components. Most research dealing with the division-of-labor concept has joined the two levels of analysis. Winsborough's (1960) early study indicated how the occupational composition of an urban place affected its position in an urban hierarchy. Lincoln and Friedland (1978) had nearly identical findings. Lieberson (1961) demonstrated that a division of labor among banks with reference to the kinds of loans made corresponds to the functional differentiation of places. Clements and Sturgis (1972) sought to explain industrial differentiation among some 600 communities in terms of physical density of population, social density, population size, and age of place. Social density (number of workers engaged in communication and transportation) was found to have the principal effect, though the combined effect of all variables was unimpressive. A weakness in the study was the use of the Gibbs and Martin (1962) index of differentiation which uses approximation to an equal distribution of employment in all first-digit industrial categories as a measure of diversification. Three of the independent variables employed by Clements and Sturgis, excluding only social density, were used together with the economic function of metropolitan area and dominance of manufacturing in a path analysis by Lincoln (1979) to explain the density, differentiation, and size of organizations in metropolitan areas. The internal structures of metropolitan areas as represented in demographic compositions were examined with functional specialization as the principal independent variable by Kass (1977).

The division of labor concept is ordinarily defined in terms that are much too narrow in Kemper's (1972) view. Differentiation affects the entire range of activities in an organization, not just the sustenance-producing functions. Kemper employs lattice theory to derive the essential properties of division of labor. But much of what Kemper regards as important eludes observation, at least in the compilation of secondary information sources. Measurement of the concept even with the readily accessible data on occupations and industries has resisted accomplishment. Gibbs and Poston (1975) attempt to remedy that situation by evaluating six different measures each of which takes into account the number of classes and population of each class. Their conclusion is that no one measure can serve all purposes.

DOMINANCE AND POWER

The issue of how dominance is exercised was early joined by Form (1954), who pointed out that the distribution of land to various uses in a city was governed by the actions of four power constellations—the real estate and building business; manufacturing, retailing, and utility interests; home buyers and other small users of land; and municipal agencies including planning commissions, zoning boards, city councils, and the courts. Form did not attempt to rank his constellations on a dominance or power scale; he was mainly concerned with revealing the institutional bases of power. Others following Form's work have dealt mainly with elites. Thus Molotch (1967, 1976) views the community as an arena in which competing groups vie over the enhancement of the land values of their respective properties. The elites through their control of government prove to be the dominant influence in the contest. Logan (1976) has carried a similar argument further by showing that the interests of elites differ in different kinds of communities. Land use control policies differ correspondingly.

A systemic view of power or dominance, terms that may be used interchangeably, is argued by Hawley (1963). He regards the urban hierarchy as a special case of a more general principle of organization. Elites are elites for the most part because they occupy key positions in the functional organization. The use of the relative numbers of managers, proprietors, and officials as a surrogate to a measure of key function roles has been shown to be associated with the degree of success in certain community projects. That community power as thus conceived is not uniformly effective has led to the suggestion that a distinction should be made between programs which affect the entire community and those which concern particular segments of the community (Smith, 1976). Aiken (1970), however, has observed that citizens' perceptions of power distribution show little relation tó an objective measure of system power, a finding which leaves open the question of what it is that citizens actually perceive.

The notion of power as a system property distributed over a hierarchy of functions is an organization principle of the first importance. It relates the phenomenon of organization to the necessary environmental dependence. A population acquires a systemic form as it differentiates relative to an environmental relationship with a key function or class of functions mediating environmental inputs to various specialized functions arrayed in transitive sequences from the key function. Functional power diminishes with each degree of removal from the key function.

SYSTEM-ENVIRONMENT INTERACTION

A renewal of interest in a theoretical rapprochement with bioecology was stimulated by Duncan's (1964) article on "Social Organization and the Ecosystem" (1964) and has been expressed most recently by Boulding's (1978) volume on *Ecodynamics*. That has been manifested in a return to elemental issues involving the uses of bioecological models.

POPULATION ECOLOGY

In the elemental definition of ecology as a study of the interaction of population with environment, the basic proposition is that the effect of the interaction is adaptation. The hypothesis contends that adaptation is achieved as population size approaches the carrying capacity of the environment. In other words, it contemplates an equilibrium between simple aggregates-population number and quantity of resources, such as was proposed by Thomas Malthus and later given mathematical expression by Pearl and Verhulst. But Wilkinson (1973), drawing upon studies of hunting and gathering peoples, especially Lee's (1968) work on the !Kung, argues that the equilibrium is struck not at a Malthusian level, but at a level of relative abundance of subsistence materials. That adds a significant qualification to the carrying capacity, as Paul Siegel (1980) shows in his penetrating analysis of the logistic model. The simplicity of that model can be enjoyed only on the analytical assumption that everything else is constant, namely, the functional structure of the system. Too often that leads to a failure to recognize the critical value of the functional structure.

It should be noted in passing that the logistic growth curve is identical with that inscribed by the demographic transition, though the assumptions are entirely different. The one assumes a slowing of growth due to a rising mortality in a context of fixed resources, while the other assumes a convergence of fertility decline upon mortality decline under conditions of access to increasing amounts of resource supplies. In both instances the measure of a demographic equilibrium is a net reproduction rate at unity. That, of course, presupposes a complex of socioeconomic circumstances that need to be, though seldom are, made explicit.

Efforts to enlarge upon the carrying capacity idea with the necessary organizational components have led a number of scholars to regard population growth as a causal agent. Boserup (1965) and Cohen (1977) are among many who regard population growth as the prime cause of technical change and organizational elaboration. That population growth is spontaneous and therefore without exogenous cause is a non sequitur, as Marvin Harris (1979) recognizes. John Bennett (1976) holds forth a promise of solution to what might seem to be causal impasse in his "ecological transition" idea. That is, as environment is progressively expanded by the spread of communication networks, "nature is absorbed into culture" and carrying capacity is no longer a matter of local determination. Even so, there is no avoiding an ultimate limitation, in Bennett's view, for in the enlarged universe the population-resource equilibrium will be reasserted eventually. Bennett appears to share the position with Catton (1978) and others that technology comprises only physical tools and the knowledge of how to manipulate them. In that case, it is reasonable to conclude that technological change offers no long-term protection against resource saturation and possible exhaustion. But, on the other hand, if technology does not include social, economic, and political techniques, there is no solution to any problem, not excluding the problem of resource conservation.

As an end state, adaptation involves a tautology of questionable utility. The circularity is avoided, however, by construing the concept as a process. Two approaches to the adaptation process are current in the literature—evolution and expansion. Both are addressed to the phenomenon of ecosystem development, but one treats the phenomenon with reference to the emergence of new species, taken one at a time, in an unfolding system and the other adopts a more holistic posture in an attempt to treat the cumulative interactions among the principal components of a system.

EVOLUTION AND ORGANIZATIONAL ECOLOGY

The conventional approach to evolution as a mode of change has been through correlation analysis, formally or informally executed. One of the more ambitious applications of that approach is that of Frisbie and Clarke (1979). They construct a multiple-factor index of technology and employ it as an independent variable against economic growth, urbanization, political modernization, bureaucratization, and stage in the demographic transition. The correlation approach, however, fails to throw light on the mechanics of the process.

An evolution model which is addressed to the manner in which the process operates comprises a sequence of variation, selection, and retention. The model has been applied by ecologists of both anthropological and sociological persuasions to populations of cultural forms (Hardesty, 1977), of occupational types (Nielsen, 1978; Lincoln, 1979), and of organizations (Hannan and Freeman, 1977; Nielsen and Hannan, 1977; Aldrich, 1979). In these adaptations of the model, the environment is a system with a limited carrying capacity for a population of units of the kind under study. Excess population leads to competition and subsequently to selection of the members of the population most successful in occupying a niche in the system. The competition is usually simplified as a two-population interaction in accordance with the terms of the Lotka-Volterra equations.

The procedure is exemplified in Nielsen and Hannan's (1977) study of the expansion of national educational systems. For each of three levels of education—primary, secondary, and tertiary—estimates were obtained for inertia as a lagged variable, cohort, and natural resource parameters. Hypotheses were developed bearing upon the effect of each parameter in the determination of the carrying capacity for each educational level in rich and in poor countries. Their results demonstrated (1) that the number of educational organizations in a given environment is determined by the carrying capacity of the environment and (2) that the observed relationship held in different levels of environmental abundance. In this particular design the competitive factor was not introduced.

Several problems in the uses of the evolution model to organizations have yet to be resolved. First, system-carrying capacity is an unknown quantity which must await an ex poste measurement. Second, it is not clear whether competition is for position within the limited carrying capacity of a system, in which case system change is problematic, or for a limited growth potential at the margin of a system, which would imply a changing amount of capacity. There is the further uncertainty as to whether an expected number of organizations surviving competition is optimal or lies at the subsistence level. A resolution of that issue would seem to require a way of dealing with organization size. It is well-known that a subsistence level for the number of organizations can be avoided by mergers, thereby reducing a large to a small number (Lincoln, 1979). Conceivably competition could bring that about. But if increase in size implies scale economies, how do organizations acquire the innovations scale economies presuppose? For the organization, "biomass" (number adjusted for average size) reaches carrying capacity before size adjustments occur.

Application of the evolution model to the survival of organizations has been so preoccupied with selection that the sources of variation have been largely ignored. It is simply assumed that organizations spring into being in enough diversity to enable selection to operate. Aldrich and Pfeffer (1976) comment on this feature and suggest a way to deal with it is in a "resource dependence model." That model assumes a capability in organizations to change themselves through entrepreneurial initiative (Aldrich, 1979). Such a view is not incompatible with competition theory by which differentiation is explained. But neither entrepreneurial initiative nor competition constitutes better than a proximate source of variation. In an ecological perspective it is necessary to account for the conditions in which initiative is or can be exercised as well as how the effects of competition are translated into diversity. The missing element, in short, is the volume and content of information flows into a system, or at a minimum, the location of a system relative to other systems.

Further exploitation of the potential in the evolution model will call for its accommodation to the phenomenon of system maturation. Growth of the system may come about through organizational or functional mutations and their establishment in new niches, that is, through evolution. Or it may result from an accumulation and integration at a time and place of preexisting forms of organization or population types, a process which corresponds more closely to what is termed succession. In the present state of knowledge it appears that a succession model is more suitable for an understanding of system growth than is the evolution model. It contemplates a series of advances in the complexity of a system, each leading to a new equilibrium state and each of which, in turn, is disrupted by environmental disturbances, the whole series culminating finally in a more or less permanent climax equilibrium. Succession is to evolution as ontogeny is to phylogeny. Operationalization of the succession model has been more effective in the plant realm (Odum, 1969) than in the human setting, largely because of the difficulties of adapting the equilibrium concept to an open system. A close empirical approximation to a phase of the succession cycle is represented in the demographic transition in which population growth moves between two equilibrium points. On the other hand, a theoretical suggestion for an approach to equilibrium in the human ecosystem is expressed in the hypothesis of asymptotic limits to nonproportional growth in the absence of compensatory change (Boulding, 1953). In that notion the tendency for interrelationships to increase exponentially as population grows arithmetically, other things remaining constant, raises communication costs to a level at which further growth is insupportable. At that point negative entropy gives way to positive entropy. But a new growth cycle may occur following a compensatory change, that is, an innovation which reduces the costs of communication. This hypothesis throws considerable light on a mode of growth which is particularly congenial to ecological theory, that is, expansion. Growth of an organized population, an ecosystem, presupposes a correlative enlargement of territory. Accordingly, system growth and the space-time dimensions of system components are inseparable concerns in human ecology.

Hannan and Freeman and Nielsen and Hannan are concerned mainly with how a given number of organizations of given types survive, or are selected, in different environments. The more inclusive problem is how organizations and ecosystems emerge. That there is a large degree of isomorphism of subsystem with system has been shown by Kasarda (1974). Kasarda and Bidwell (1980) develop a theoretical argument in greater detail than previously attempted to account for the formal properties of organizations as emergences from the population-environment interaction. They give special attention to environmental perturbations, productivity effects, parent system protection to member organizations, and information feedbacks as they bear on other inputs to the subsystem. This model is designed for a study of input-output flows in public school systems (Kasarda and Bidwell, forthcoming).

EXPANSION AND THE SPATIAL PATTERN

Expansion has long been recognized in economic history. Its use in human ecology dates from Burgess's (1925) application to local community growth and from McKenzie's (1934) employment of the concept to the extension of functional organization to regional and interregional scope. Expansion involves a thickening web of interdependences among a growing core of organizations, an enlarging area of settlement, and a scatter of subcenters together with population redistributions appropriate to the changing personnel requirements of an increasingly complex system. This process is observable at the local level, that is, in the growth of the city, at a regional level, as in the formation of a metropolitan community, and at an interregional level as in the maturation of national and international systems.

Since the characteristics of each stage in the expansion process have been recently reviewed (Hawley, 1978), it is not necessary to repeat them here. A heuristic consequence of the expansion phenomenon is that the metropolitan area has replaced the city as the urban unit for many research purposes. If there had been any doubt of the wisdom of that shift it should have been removed by Kasarda's (1972) demonstration of a strong positive relation of the amount of employment in integrative agencies in central cities of metropolitan areas with the sizes of tributary areas.

EXPANSION AND POPULATION DISTRIBUTION

The movements of people incidental to system expansion are complex and have varied over time. Long-distance movements to central cities have been countered by short-distance movements from cores to progressively widening peripheries and each current has exercised a different population selectivity. The migration literature documenting these trends is far too voluminous to summarize here. It can be said that the theoretical basis for research on long-distance migration has advanced very little since the historian Haddon (1919) recognized the operation of push and pull factors. Since then, equilibrium models of various designs and combinations of variables have built on the simple dual-causation idea. Progress has consisted mainly in clarifying measurement problems and improving estimation procedures.

Studies of short-distance centrifugal population movements have been descriptive accounts for the most part. An exception was produced by Sly (1977). He employed what he called an organization model in which migration within metropolitan areas is regarded as a response to organization changes operationalized as an index of industrial dispersion and percent of population unemployed, technology (value added by manufacturing and net commutation to central cities), and environment (central city density, percent of population nonwhite, and percent of central city jobs held by nonresidents). A multivariate analysis yields very modest support for the propositon, perhaps because measures of change in the independent variables were not included. Contrary results were obtained by Frisbie and Poston (1978) in their study of migration changes in relation to the sustenance organization in nonmetropolitan counties. Using factor analysis to identify latent factors in industrial structures of counties, they then applied multivariate analysis to the factors and a set of independent variables with positive results.

Until recently it may have been reasonable to expect that population movements in metropolitan and nonmetropolitan areas were qualitatively different. That may in fact have been true in the years prior to the late 1960s and 1970s. But current information has indicated an increasing tendency for metropolitan deconcentration movements to operate on a regional and interregional scope, actually reversing trends of population decline in many nonmetropolitan counties (Wardwell, 1977). Strangely enough, the investigations into that phase of redistribution have been content to deal only with migrants' verbalized preferences for place of residence to the almost complete neglect of processes of structural change.

An important question that has been overlooked by ecologists, though not by geographers (Zelinsky, 1971; Compton, 1976; Fuchs and Demko, 1978; Kosinski, 1975), concerns the extent to which commutation movements together with ancillary flows of communications and materials have been substituted for residence changes. It is quite probable that the relative frequency of the latter has declined. The difficulties involved in standardizing the different orders of data required for testing the proposition may account for its lack of attention.

EXPANSION AND TECHNOLOGY

Technology has gained increased attention as an independent variable, particularly in comparative studies of system growth. So inclusive is the concept, however, that its use demands a selection of some one part or a few parts having high index value for the totality. Techniques for spatial mobility, including communication as well as transportation techniques, would seem to serve that purpose. In addition to their manifold implications for access to information, the occurrence of invention, and cultural accumulation, improvements in the techniques for movement are the sine qua non for increases in organization scale in all its forms. On no other basis could there have been an enlargement of organized life from local to regional to interregional scope. Numerous studies have reported on the critical importance of facility in transportation and communication. The central importance of transportation change in metropolitan development was noted by Hoover and Vernon (1957) and by Zimmer (1978). A regression analysis performed by Clemente and Sturgis (1972) of population size, physical density, age of place, and number of people employed in communication and transportation relative to industrial diversification found that only the measure of social density was significantly related to the dependent variable. Olsen (1968) also found that the number of motor vehicles in a country was the best predictor of its political modernization.

Expansion is only possible as long as the efficiency of movement continues to be improved or until the facility gained in the last improvement is spent. With a static technology for movement, growth is limited by the costs of congestion. As the cost of communication and transportation approach an upper symptote, a system equilibrium is approximated. Unfortunately, this theoretical argument has not yet been subjected to empirical test.

THE WORLD SYSTEM

Expansion, needless to say, has carried the scope of territorial organization well beyond national boundaries to world dimensions. While that was recognized in the ecological writings of McKenzie almost half a century ago, only recently have ecologists turned their research attention to organization of that scale. The enabling circumstance in this as in comparative studies generally has been the production of large data files by the United Nations statistical services. Thus it has become possible to proceed to a quantitative analysis of various propositions concerning international or interstate organization. For example, the Gibbs and Martin (1962) study mentioned previously showed through correlation analysis that both the amount of urbanization and the division of labor in a country were dependent on the extent of interregional linkages with respect to sources of materials consumed. Current work has utilized panels of nation-states in studies concerning national political and economic development as affected by external relations (see Meyer and Hannan, 1979). Most of this work is cross-sectional, though lag effects are introduced. The process of expansion, in other words, is not analyzed. It is also somewhat strange that transportation and communication technology is rarely touched upon in that work. A notable exception is Delacroix's (1979) use of information inputs in the form of book translations and foreign films in his study of economic growth.

The world system concept, however, has yet to be explored empirically in other than a Marxian framework. There is much more structural complexity to contend with than is represented in the core-periphery model. Here again it would seem there is opportunity to investigate the utility of network theory. That may well be forthcoming in the early future.

ECOLOGICAL AND INSTITUTIONAL CONVERGENCE

That there has been a marked convergence of the two macro-level approaches in sociology is apparent to all who have kept abreast of the literature. There has been, on the one hand, a movement of the ecological approach toward the institutional perspective out of a growing recognition that adaptation is necessarily a process of system development and that the critical elements of environment are increasingly intersystemic relations. On the other hand, the institutional approach has drawn toward the ecological perhaps because the latter has been ihstrumental in identifying many of the important problems for the parent discipline and has also taken the leadership in bridging disciplinary boundaries. The convergence of trends is most visible in the similarity of phenomena selected for study. These include the structure of organization and of interorganizational relations; urbanization and its relation to societal properties; hierarchy in roles, organizations, and cities; the nature of and distribution of power; the manifestations of the temporal dimension in collective life; change conceived as evolution in some instances and as growth or expansion in others, to name but a few of the more salient common interests.

Yet the two approaches retain certain important differences. The institutional approach, as Meyer and Hannan (1979) point out, is characteristically normative in its conception of organization and in the variables it employs. That is to say, norms are commonly treated as the principal independent variable. Teleology figures prominently in its assumptions. Human ecology, in contrast, views organization as a product of the interaction of population and environment. Norms, a term for regularities in organization, when they are given explicit treatment at all, are viewed as dependent rather than as independent variables. The emphasis in ecology upon the population rather than the individual as the unit of observation and its view of causal forces as impersonal rather than personal, together with its way of stating its problems, will doubtlessly preserve its distinction from the institutional approach. Nevertheless, the convergence of the two points of view must be regarded as constructive if only because it has aided in the correction of excesses that have tended to occur in the past.

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