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ORGANIZATIONAL ECOLOGY

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Abstract

Recent research on organizational ecology is reviewed. Three levels of analysis and approaches to evolution are distinguished: (*a*) the organizational level, which uses a developmental approach; (*b*) the population level, which uses a selection approach; and (*c*) the community level, which uses a macroevolutionary approach. Theoretical and empirical research is critiqued within this framework. Proposals to develop organizational taxonomies are considered.

INTRODUCTION

Although the intellectual descendant of human ecology (e.g. Hawley 1950, 1968), the emerging field of organizational ecology differs from its predecessor in a surprising number of fundamental ways. The major trends of ecological rethinking since Hawley's (1968) classic statement of the principles of human ecology include:

1. a shift in evolutionary analysis from a developmental approach to a selection approach;
2. a shift from theories that emphasize symbiotic relations between social units to theories that emphasize competitive relations;
3. a shift from deterministic models to probabilistic models;
4. a shift from theories that assume temporal equilibrium to theories that explicitly emphasize disequilibrium.

Some of this rethinking reflects changes in the social sciences generally, but other aspects are the direct consequence of Hannan & Freeman's (1977) influential theoretical paper on the population ecology of organizations. The identification of organizational ecology with the ideas in this article is both fortunate and unfortunate. It is fortunate because this provocative essay revived

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interest in the ecological paradigm, arousing critics as well as advocates. It is unfortunate because this identification has led to the equation of organizational ecology with the population ecology of organizations. In fact, population ecology is only one of several possible levels of ecological analysis. It also uses only one of the various possible approaches to evolutionary analysis.

As with bioecology, organizational ecology has yet to find the single most important level of analysis. In current research, three levels of analysis can be distinguished. The lowest level—the organizational—involves the study of demographic events and life-cycle processes across individual organizations. This area of study is called *organizational demography* and it typically uses a *developmental approach* to study evolution.

The study of populations of organizations constitutes a second level of ecological analysis. Research on this level, defined as *population ecology*, concentrates on population growth and decline, as well as on interactions between multiple populations. Evolutionary theory is integrated with ecology at this level through the use of a *selection approach*.

The third level of analysis studies *community ecology*, defined as "the collection of all the populations that live together in some region" (Roughgarden 1979:295). Research at this level relies on a *macroevolutionary approach* that is primarily concerned with the emergence and disappearance of organizational forms.

In this review, I will show that important ecological research on organizations has occurred at each level of analysis. I will also observe that, although research continues at all three levels, the interest given to each level has shifted over time. I also hope to demonstrate that interesting research questions remain to be answered at each level of analysis.

The next section of the paper reviews the three evolutionary approaches to the study of organizations. The third section considers the role of taxonomic research in organizational ecology, while the fourth discusses the empirical research in organizational ecology.

EVOLUTIONARY ANALYSIS

Much previous sociological theory equated evolution with progress or advancement. These theories commonly outlined stages of evolution in the development of societies or organizations; these evolutionary sequences were typically unilineal and deterministically applied (see Granovetter 1979 for a discussion and critique).

Recent ecological theory, on the other hand, emphasizes the multilineal and probabilistic nature of evolution. Thinking has shifted so much in this direction that, as with bioecology, evolution is no longer equated with progress, but simply with change over time. In modern organizational ecology, much of this

rethinking is only implicitly evident in the mathematical models used to study change: The time paths predicted by these models can be extremely complex and often contain a large random component.

The Developmental Approach to Evolution

Proponents of the developmental approach assume that organizations change structurally over time and that the form of change is shaped by structural pressures and constraints. Developmental theory uses an embryological metaphor (Cafferata 1982) and encompasses much of mainstream organizational theory [see Scott (1975) for a thorough review]. This research often is not explicitly ecological, but many of its concepts have been heavily influenced by early ecological theory. For example, organizational conceptualizations of isomorphism and the environment originated in the ecological research of Park (1923, 1929) and Hawley (1950, 1968).

The clearest explicitly ecological statement of the developmental approach to organizations can be seen in Kasarda & Bidwell (1984). Briefly stated, this approach casts theory at the organizational level of analysis, using a focal organization perspective. The organization is seen in its environmental context, depending on external resources for sustenance. Environmental conditions constrain the organization and shape organizational structure; however, internal constraints such as size and technology also affect its structure. Theorists differ in the emphasis they place on internal versus external determinants of structure.

Developmental theorists assume that organizations are highly adaptive: structural changes occur in response to internal and external stimuli. The ecological perspective, however, has always emphasized the noncognitive aspects of these changes (Duncan & Schnore 1959; Hawley 1968). Ecological theories of adaptation also tend to be deterministic, to be based on an assumption of temporal equilibrium, and to have an emphasis on symbiosis (Hawley 1968, 1978). Change is also assumed to be irreversible (Cafferata 1982). Recent research using this approach examines organizational life cycles (Kimberly & Miles 1980) and organizational responses to industrial evolution (Miles 1982).

The Selection Approach to Evolution

Despite early attempts by Park (1923, 1929) and more recent efforts by Aldrich (1971) and Kaufman (1975), the selection approach did not blossom until Hannan & Freeman's (1977) paper on the population ecology of organizations. This article directly challenged many of the central tenets of the developmental approach. Hannan & Freeman asserted that organizations are not primarily adaptive, but largely inertial. They argued that the dominant mechanism of social change is natural selection, governed by competition and environmental

constraints. They also advocated a shift from the organizational to the population level of analysis and proposed dynamic models of organizational change that are probabilistic and do not assume a state of temporal equilibrium. Working from such a perspective, they argued, analysts would be able to answer the important question, Why are there so many kinds of organizations?

Aldrich (1979) linked the selection approach to the general literature on organizational theory and fleshed out the evolutionary logic of population ecology. Using Campbell's (1969) conceptual scheme, he characterized evolution as a three stage process consisting of variation, selection, and retention. Organizational variation is an essential precondition of selection; however, it can be assumed exogenously (as in most of Freeman & Hannan's work), or it can be explicitly taken into account [as in Stinchcombe's (1965) attempts to explain the rise of organizational forms]. The latter strategy is more satisfying from a general intellectual stance but is not required for modeling selection processes (see, for example, Carroll & Delacroix 1982, Freeman & Hannan 1983).

The second stage, selection, posits a mechanism for the elimination of certain types of organizations. Elimination can occur through any type of organizational mortality: dissolution, absorption by merger, or radical transformation. The mechanism of elimination is usually an environmental condition; thus, the key predictor of organizational survival is an interaction variable composed of organizational form and environmental condition (see Freeman 1982).

The final stage is retention. In formal organizations, retention is not (as in biological organisms) a generational problem—formal organizations can in theory be immortal. Instead, retention is a structural problem: Organizations with advantageous traits must not lose them through incremental change. In a recent elaboration of their position on this issue, Hannan & Freeman (1983) have argued that the evolutionary role of inertia is to reproduce the organizational structure so as to ensure accountability and reliability. This role is retentive, and, following Scott's (1981) suggestion, it is seen as applicable primarily to the core rather than the peripheral structures of organizations. Thus characterized, organizations are more adaptive than the original statement of population ecology implied, but inertia now plays a more central role in organizational evolution by providing the basis for selection.

As Freeman (1981) has indicated, the three stage model is problematic because it gives the impression of a sequential, linear process when, in fact, all three stages operate simultaneously. The model also has the disadvantage, as does Hannan & Freeman's (1977) theoretical statement, of characterizing organizational mortality as the major force driving natural selection.[1] This

[1]This characterization is perhaps the most potentially serious problem with existing empirical applications of population ecology. For example, in a study of restaurant mortality, Freeman &

characterization constitutes a serious misunderstanding of what Freeman (1982) has called the "population logic." As Pianka (1978:9) has explained, "Ultimately, [natural selection] operates only by differential reproductive success." Due to the potential immortality of formal organizations, this statement is somewhat too strong for organizational ecology. The main point still applies however: population ecology predicts net mortality (deaths over births), which has very little to do with the life chances of individual organizations.

The fundamental incongruence between the assumptions underlying the population ecology approach and the developmental approach has generated substantial criticism of population ecology. Although others (e.g. Van de Ven 1979, Astley 1980) have expressed their concern, Perrow has been the most vociferous critic (1979). His criticisms merit detailed review because of the clarity of his ideas, the comprehensiveness of his attacks, and the extent of his influence in the field.

Perrow's (1979:237–43) criticisms of the population ecology perspective begin by displaying a misinterpretation: He equates organizational ecology with Spencerian notions of evolution, including the view that evolution represents progress and is based upon the survival of the fittest. In these and other remarks, Perrow's intellectual criticisms are entangled with his political values. He argues that, for reasons of social control, large organizations are the most important to study and that they rarely die. The implication, which has been echoed by Aldrich & Pfeffer (1976 and Pfeffer 1982) and Scott (1981), is that the selection approach only applies to small (and in Perrow's eyes, insignificant) organizations.

While small, and new organizations have higher failure rates, large and older organizations also fail. As Freeman (1982:4) has shown in a demographic analysis of large firms in the United States from 1967 to 1972, "appearances and disappearances in the population over 5 years sum to half the population size at the beginning of the period." Moreover, over the long run large organizations do not appear to be securely dominant at all: Hannan & Freeman compared the *Fortune 500* between 1955 and 1975 and found that only 53.6% of those on the list in 1955 were still there in the same form in 1975. They also noted that "of the thousands of firms in business in the United States during the Revolution, only 13 survive (in 1977) as autonomous firms and seven as recognizable divisions of firms" (1977:960).

Perrow argues that the selection approach is limited to competitive, market-based industries because "we simply do not let schools and garbage collectors go out of business" (1979: 242). For schools, this statement is simply incorrect. In a study of American colleges and universities in 16 states from before the

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Hannan (1983:1143) write: "It is difficult to imagine that entrepreneurs would be so perverse as to found specialist firms at disproportionately high rates in those environments in which their half-lives are much shorter than those of generalists."

Civil War to 1927, Tewksbury (1932) found that 412 of the 516 colleges founded had died. In frontier states such as Arkansas the mortality rate was 100%, while in settled areas such as New York *only* 58% of the colleges and universities failed. Schools may be even more unstable in the modern era. As a result of consolidation, the number of school districts in the United States declined from 127,108 in 1930 to 15,174 in 1974 (US Bureau of the Census 1975). Moreover, in 1983 California was the home of approximately 1600 private postsecondary educational institutions whose rates of entry and exit were astounding: Approximately one new institution was founded *every day* and approximately one established institution failed *every day* (Council for Private Post-Secondary Educational Institutions 1983).

Perrow would probably respond by arguing that the majority of California's 1600 postsecondary educational institutions are trivial and insignificant. But in modern societies most organizations are small—very small. Consider for instance the census that Churchill (1955) reported. In 1952, there were 4.2 million operating businesses in the United States: Only 0.1% of these had more than 1000 employees, while more than 75% had less than 4 paid employees. Aldrich (1979) has used governmental sources to document similar phenomena in recent times.

Not only are small organizations present in large numbers, but they represent an important segment of the labor force. In 1975, 44.9% of the approximately 69,000,000 US workers were employed by organizations with less than 100 employees, and almost 22% were employed by organizations with less than 20 employees (US Department of Labor 1976). Small organizations also generate a disproportionately high percentage of the economy's new jobs. Birch (1979) found that independent firms with 20 employees or less generated 51.8% of all new jobs in the United States between 1969 and 1976. A more recent study by the US Small Business Administration (1983) presents similar data for the period after 1976.

Perrow has argued that the orienting question, Why are there so many kinds of organizations? is inappropriate because in modern societies there is "not much variation among [social] units" (1979:242). He uses the American automobile manufacturing industry to support this claim, asserting that the Big 3 firms—General Motors, Ford, and Chrysler—are all similar. Although these firms do differ in the number, size, and combination of their subunits, they probably have many important structural similarities. But in his analysis of this industry, Perrow makes two fundamental mistakes. The first is an incomplete delineation of the firms in the industry; he ignores the smaller, specialized automobile manufacturing firms such as Avanti in South Bend, Indiana. From everything we know about organizational size, these are surely different "kinds" of organizations from the Big 3.

Perrow's second analytical mistake is to view the industry through a very limited historical lens. Epstein (1927) has shown that between 1903 and 1924

the US automobile manufacturing industry contained 180 companies; even more firms were selling automobiles. Using Thomas's (1977) data, Lawrence & Dyer (1983) showed that in 1910 there were over 200 firms in the automobile industry. The selection perspective seems particularly well equipped to explain how this industry has changed over time, why a few firms have grown to dominate the industry, and what the conditions were that caused so many firms to fail.

The Macroevolutionary Approach

The least explicitly organizational stream of ecological research is what I call the macroevolutionary approach. The theoretical logic of this approach is similar to the developmental approach's, although a higher level of analysis is assumed. Whereas developmental theorists focus on change over time in individual organizations, macroevolutionists examine communities of organizations.

Macroevolutionary research has developed along two separate lines. The first involves analysis of whole societies and is typified by the work of Sahlins & Service (1960), Lenski & Lenski (1974), and Harris (1977, 1979). Researchers using this approach attempt to identify the structural characteristics of societies and to analyze societal changes over long historical periods (Duncan 1964). Historically, empirical work in this tradition has included only global indicators and compared several societies at most. In recent research on the world system, however, many countries are examined simultaneously and multivariate analysis is employed (see, for example, Wallerstein 1974, Bergeson 1980).

The second line of macroevolutionary research lies within urban sociology. Emanating from the early Chicago school of Burgess (1925), Park (1926), and McKenzie (1924, 1926), adherents of this tradition examine changes in cities over time and, more recently, in whole systems of cities over time (e.g. Berry & Kasarda 1977, Pred 1966). Although it is truly sociological in character, this research is being increasingly dominated by geographers (but see B. Duncan & Lieberson 1971).

Macroevolutionary research uses much of the logic inherent in the developmental approach. For example, the analyses of organizations by Greiner (1972), of societies by Lenski & Lenski (1974), and of cities by Hawley (1971) all propose deterministic evolutionary sequences for the transformation of social units over time. The difference in the level of analysis used in the two approaches has profound implications, however. Most importantly, the macroevolutionary approach encompasses organizational selection, while the developmental approach does not. By focusing on large-scale changes in communities of organizations, macroevolutionary research in essence describes the rise and fall of organizational forms (sometimes referred to as succession). This approach to selection differs even from population ecology. Population ecolo-

gy posits that natural selection is manifested through rates of organizational reproduction and survival. Macroevolution posits selection of organizational *forms* as manifested through rates of form emergence and survival against form extinction (see Stanley 1979 for further discussion of natural selection vs species or form selection).

Most researchers who study organizations probably see macroevolutionary research as irrelevant to their work; such opinions will surely change in the near future. Macroevolutionists are increasingly discovering a need for detailed organizational analysis [see, for example, Skocpol's (1977) discussion of the state and Pred's (1975) discussion of the role of organizations in interurban hierarchies]. As organizational analysis becomes more concerned with long-term historical transformations, organizational theorists are increasingly finding the need for more substantive, yet theoretically-based, characterizations of the environment (see Brittain & Freeman 1980). The substantive traditions containing macroevolutionary research are natural sources (e.g. Turk 1970, Warren 1967). Moreover, the systematic empirical study of form selection shows great promise for increasing our understanding of the general path of social evolution.

THE TAXONOMY ISSUE

Ecological theorists have divided into two camps on the role of organizational forms in ecological research. The first camp, led by Hannan & Freeman (1977), takes the position that organizational forms ought to be defined within the context of the research problem under study. Although Hannan & Freeman (1977:934) argue that "we can identify classes of organizations which are relatively homogeneous in terms of environmental vulnerability," they go on to claim "that the populations of interest may change somewhat from investigation to investigation depending on the analysts' concern. Populations of organizations referred to are not immutable objects in nature but are abstractions useful for theoretical purposes."

Their position can be illustrated with the newspaper industry. Populations of newspaper organizations might be differentiated for one analysis along the dimension of niche width, ranging from specialism to generalism; for another analysis, by location, e.g. center city vs suburb; for others, by the extent of vertical integration or by size; and so on. Hannan & Freeman argue that the relevant organizational dimensions for grouping populations (and combinations thereof) are potentially infinite and that it makes sense to draw such distinctions only in the context of a specific substantive or theoretical research problem. Such statements make it clear where this camp's energy is invested: in modeling and theory. This orientation partly explains their reasoning. But another explanation is epistemological: Hannan & Freeman (1977:935) assert

that "there is no reason to limit a priori the variety of rules or functions that may define the relevant blueprints [for organizational action]."

McKelvey (1975, 1978, 1982) has been the most visible proponent of the second camp, although Warriner (1977) has made similar arguments. Members of this camp argue that the development of organizational ecology requires a science of organizational classification and taxonomy. In justifying this position, McKelvey & Aldrich (1983:125) reason, "A theoretically grounded empirical taxonomy would provide a conceptual framework for describing and understanding the diversity of organizational populations, and would identify populations useful for research on other substantive concerns about organizations." Such an opinion requires a somewhat absolutist definition of organizational form.

The research strategy of this camp differs substantially from the first camp's. Given data on newspaper organizations, for example, the first step in their analysis would be to compare the organizations along all available dimensions (see Ulrich 1983 for an illustration). Distinct organizational forms or populations would be identified, and these groupings would then play a pivotal role in theorizing. But most important of all, McKelvey & Aldrich (1983) state, these forms could be used to identify the limits or boundaries of generalization. Such limits would then allow researchers to categorize their findings and would consequently make organizational theory more readily applicable to managerial problems.

Adherents of these camps have clearly taken positions at odds with each other, and their differences have major implications for the conduct of research. How is the taxonomy issue to be resolved? Consider each position again. McKelvey is correct in chastising organizational researchers for their insensitivity in generalizing their empirical findings. At best, there seems to be only an implicit concern with the limits of generalization, i.e. with what Zelditch (1969) has called the conditions for application of a theory. This criticism holds for other organizational ecologists as well. For instance, when Freeman & Hannan (1983:1143) assert that a very complex model of niche width that works beautifully for restaurants will "hold for all kinds of organizations," the reasonable observer must be skeptical (regardless of the elegance of the model or the persuasiveness of the test).[2]

[2]Freeman & Hannan's (1983) insensitivity on this matter stems in part from their failure to distinguish adequately between organizational forms and organizational strategies. Forms are specific blueprints for organizational action. Strategies are also blueprints, but at a higher level of abstraction; they encompass concepts such as specialists and generalists, each of which normally includes a number of disparate forms. Freeman & Hannan often equate the two concepts and almost always assume that specific forms imply certain strategies (but see also Brittain & Freeman 1980). Since form represents structure, such reasoning surely assumes a tighter coupling between form and strategy than is justifiable. A greater concern with the generalizability of research findings would most likely lead to a better specification of these concepts.

McKelvey is incorrect, however, when he implies that the conditions for application of a theory will coincide with the organizational forms or populations. While the limits to generalization may indeed be delineated by forms, previous research suggests that generalizations are more likely to be limited by such abstract dimensions as the degree of centralization. The problem arises because these dimensions may either vary within forms or be constant across many forms. Moreover, when numerous possible dimensions are simultaneously under study, one has to wonder whether the effort has any meaning beyond current practices that define a study as being limited to, say, newspaper organizations.

Rather than attempting to identify the limits to findings immediately and definitively, a more fruitful strategy might be to try to explain anomalous findings as they arise. That is, when contradictions appear one should ask: What are the important organizational differences between this sample and others that yield different findings? Within such a research strategy, sampling schemes using homogeneous samples (such as those proposed by McKelvey & Aldrich 1983) seem to have real value. But they still have a very high cost. In nonexperimental research, high quality estimation depends on the availability of data with wide variation in the independent variables. Thus, one wants wide variation across the scope boundaries of a theory so that the presence or absence of an effect can be ascertained. McKelvey's strategy would disregard this important factor and, on the whole, would probably lead to fewer interesting empirical findings.

What role can taxonomies play in organizations research then? In bioecology, taxonomists play an important role as natural historians, observing and documenting important, qualitative evidence. This role might also be played by organizational taxonomists; it seems less necessary, however. In biology, lizards must be studied closely because they lie outside our experience, and we do not really know how they spend their time. In contrast, formal organizations do lie within our experience: we work in them, live in them, and participate in their activities on a daily basis. Moreover, some social scientists—and many journalists—already regularly file "natural history reports" in the trade publications and the popular press. Thus, McKelvey's proposals seem to be valuable primarily for sensitizing researchers to the generalization problem. As a result, more effort will probably be devoted to the description of organizational data sets. These descriptions will be invaluable as researchers seek to explain anomalous findings.

EMPIRICAL RESEARCH

The general trend in empirical research on organizational ecology has been from static analyses of cross-sectional data, where temporal equilibrium must

be assumed, to dynamic analyses of longitudinal data, where the equilibrium assumption can be relaxed. Undoubtedly, this shift has occurred because of the increased attention that ecological theorists have given to processes of change.

Organizational Demography

FOUNDINGS Empirical studies of organizational births have been conducted for the following types of organizations: sheltered workshops for the handicapped (Kimberley 1975); governmental bureaus (Kaufman 1976, Casstevens 1980); credit reporting agencies (Aldrich 1979); producers' cooperatives (Aldrich & Stern 1983); newspapers (Delacroix & Carroll 1983); telecommunications, plastics and electronics manufacturers (Pennings 1982); and women's medical societies (Marrett 1980). Following Stinchcombe's (1965) lead, most of these studies examine patterns in organizational foundings over time and attempt to relate variations in these patterns to the characteristics of the organizational environment—e.g. resource abundance, organizational density, political turbulence. Undoubtedly, these exogenous variables explain much of the birth process; however, there may be intrinsic patterns of organizational birth that are driven by the population dynamics of industry evolution.

Figure 1 displays the patterns of organizational foundings in six different "industries."[3] Although widely varying in scale and function, the organizations in these industries are comparable because they represent the complete populations of their respective organizational environments. In panels *a* and *b*, newspaper births in Argentina and Ireland follow a distinctly cyclical pattern. Delacroix & Carroll (1983) have demonstrated that these patterns can be explained by the interrelated dynamics of organizational births and deaths, as well as by exogenous political turmoil.

Although the shorter observation periods and smaller sample sizes require caution in interpretation, panels *e* and *f* of Figure 1 show an apparently different pattern of organizational foundings. The establishment of both domestic airlines and commercial banks follows a unimodal, concave pattern. This pattern also differs from that shown in panels *c* and *d* for the local newspaper industry in Elmira, New York and for fraternities and sororities at the University of California, Berkeley. These plots display an intermediate pattern resembling multiple waves of the concave pattern. Although the pattern almost appears to be cyclical, the primary difference is that there are a number of years when no organizations are founded. This is a major substantive difference which needs

[3]Sources for these data and those shown in Figure 2 can be found in Carroll & Delacroix (1982) for Argentine and Irish newspapers, Carroll (1984) for American newspapers, US Bureau of the Census (1975) for operating railroads and scheduled air transportation operators, Phillips (1971) for domestic airlines, US Federal Reserve (1959) and US Federal Deposit Insurance Corporation (Various Years) for commercial banks, and University of California (Various Years) for University of California at Berkeley (UCB) fraternities and sororities.

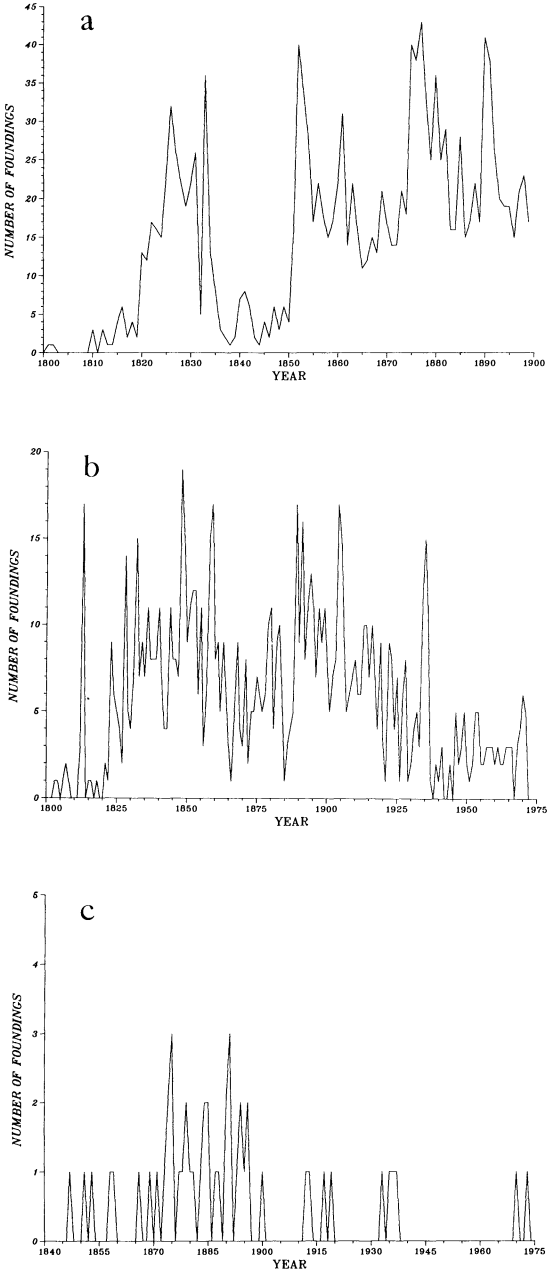

Figure 1 Patterns of organizational foundings: (*a*) Argentine newspapers; (*b*) Irish newspapers; (*c*) newspapers in Elmira, New York.

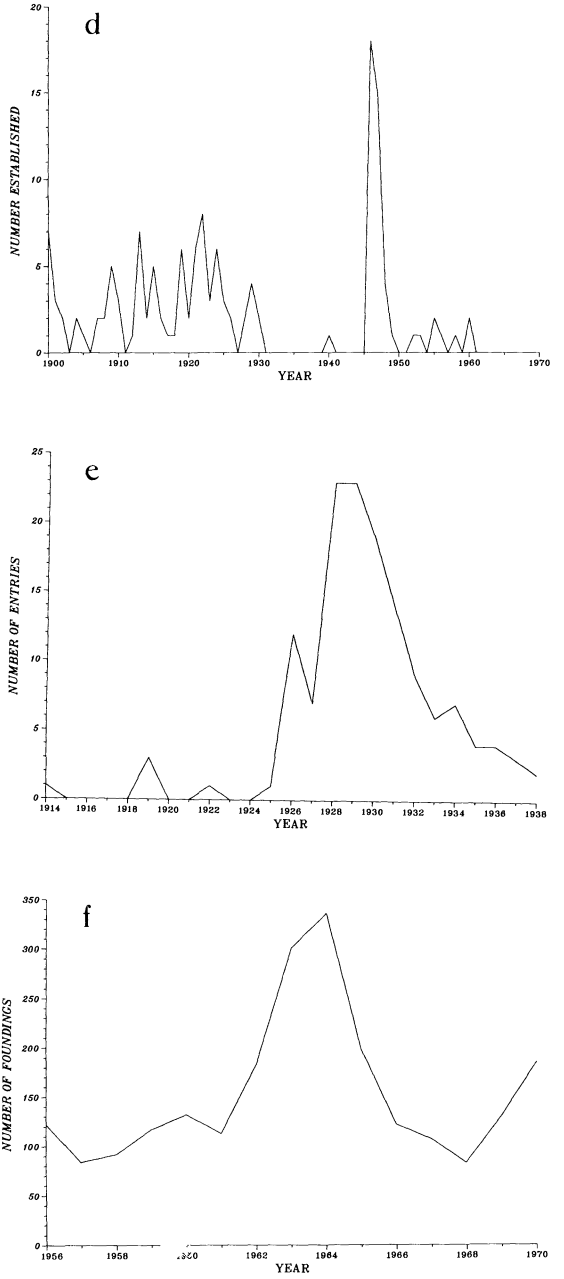

Figure 1 (continued) (*d*) University of California at Berkeley fraternities and sororities; (*e*) domestic airlines; (*f*) commercial banks.

to be explained. Indeed, the lack of available explanations for these patterns (or others that may exist) indicates the important research problems that await attention.

GROWTH AND DECLINE The growth and decline of organizations are more conventional topics that are commonly discussed in the literature. For recent reviews, see Whetten (1980) and Child & Kieser (1981).

DEATHS Policy experts have studied business failure or, more generally, organizational mortality for at least fifty years (for a comprehensive review, see Carroll 1983). Heilman's (1935) work typifies the classical approach to the problem. In describing the reasons for failure in 12,000 firms, he summarized: "Most closings occur because a proprietor, who is not fitted by training and temperament for a particular enterprise and who is inadequately financed, undertakes to enter a field that is already satisfactorily served" (1935:7). The modern policy approach differs only slightly. The most authoritative analysis—by Dun & Bradstreet (1978)—proposes that 48.5% of the 7,919 business failures in 1977 were caused by inappropriate managerial experience. Another 44.6% were claimed to be due simply to incompetence.

Ecological researchers of organizational mortality take quite a different perspective. Unlike the business policy experts, who attribute organizational failures solely to factors internal to organizations, ecologists argue that many failures are due to causes external to organizations. From the policy perspective, this position is radical, if not blasphemous, for it implies that business failure (and by implication, success) often cannot be controlled by managerial initiative.

Empirical studies of organizational death have been conducted within the ecological framework for the following types of organizations: neighborhood retail businesses (Aldrich & Reiss 1976), governmental agencies (Kaufman 1976, Casstevens 1980, Starbuck & Nystrom 1981), semiconductor manufacturers (Freeman et al 1983), national labor unions (Freeman & Brittain 1977; Langton, Unpublished work, 1982; Freeman et al 1983), television stations (Stearns 1982), railroad companies (Marple 1982), newspapers in Argentina and Ireland (Carroll & Delacroix, 1982), large American corporations (Amburgey 1983), restaurants (Freeman & Hannan 1983), American local newspapers (Carroll 1984), and an assorted collection of retail, wholesale and manufacturing organizations (Carroll 1983).

Two major findings have emerged. First, organizational mortality rates consistently display a negative relationship with age, supporting Stinchcombe's (1965) arguments about the liability of newness (Carroll & Dela-

croix 1982, Freeman et al 1983, Carroll 1983).[4] The effects of age persist in the face of controls for size, historical time, and population heterogeneity (Freeman et al 1983). Makeham's Law, a stochastic model of the hazard function with age-dependent properties, is becoming accepted as the baseline model for the study of organizational mortality (Carroll & Delacroix 1982, Freeman et al 1983, Carroll 1983).

The second major finding concerns types of organizational death. Ecologists consider any loss of a distinctive form of social organization as a death, regardless of the overt mechanism involved. Empirical research has consistently uncovered major variations in the patterns of dissolution, merger absorption, and ownership transfer (Freeman & Hannan 1983, Carroll 1984, Freeman et al 1983). Explanations of these variations should be a major preoccupation of ecological theorists.

Population Ecology

FOUNDINGS AND DEATHS Research on foundings and deaths has a population ecology interpretation when an independent variable interacts organizational form with environmental condition. Two studies of organizational mortality have relied upon this theoretical interpretation. First, Freeman & Hannan (1983) estimated a model relating the niche-width dimensions of generalism and specialism to the environmental conditions of uncertainty, variability, and grain, using data on restaurants in 18 California cities. Second, Carroll (1984) estimated a model for the newspaper industry using the same dimensions of organizational niche width but the more conventional environmental condition of market concentration. What is needed here are more studies of foundings, especially when coupled with mortality analyses.

POPULATION GROWTH, DECLINE, AND INTERACTION Two parametric models dominate ecological research on populations of organizations: the logistic model and the linear partial-adjustment model. Both models assume that growth is curvilinear and specify a ceiling on population size, which is referred to as the carrying capacity. The models differ in their specification of the early stages of the growth process. In the linear partial-adjustment model, the rate of growth is fastest at the beginning of the process. In the logistic model, growth is fastest at the midpoint of the process and growth is slow early on. These assumptions yield an S-shaped population curve for the logistic model and a curve with a monotonically decreasing slope for the partial-adjustment model. The two models converge as they approach the ceiling.

[4]For a possible exception, see Aldrich & Staber's (Unpublished work, 1983) preliminary analysis showing an apparent increasing age dependence among trade associations.

Although ecological theorists (e.g. Hannan & Freeman 1977, Aldrich 1979) commonly specify the logistic model, the linear partial-adjustment model is frequently used in empirical research instead due to estimation difficulties with the former (especially when one is dealing with multiple populations). This misspecification is probably insignificant, however, because researchers rarely have data on the beginning of organizational populations, i.e. the point where the models diverge the most.

Organizational carrying capacity is typically specified in these models as a function of exogenous variables that are thought to drive the process of population growth.[5] So, for example, Nielsen & Hannan (1977) postulated that the size of educational organizations depends on the societal resources available, the population size of relevant age-groups, and the number of qualified students (for other examples of such specifications see Hannan & Freeman 1978, Carroll 1981). This characterization accurately captures the materialistic flavor of ecological thinking, but it unfortunately neglects any of the internal dynamics of population growth and decline. Industry evolution is probably driven by both exogenous and endogeous factors.

Figure 2 shows plots of the number of organizations in six "industries" over time. The similarities in the long-term patterns of evolution of these six disparate industries strongly suggest that there is an intrinsic dynamic of contraction and expansion. Each industry is exposed to a widely varying set of exogenous conditions, yet each shows (or would show with more complete data) a long-term concave pattern of growth and decline in the number of organizations. Panels *b*, *c*, *e* and *f* demonstrate this pattern quite clearly for Irish newspapers, American daily newspapers, domestic and international air transportation operators, and commercial banks. In panel *a*, the population of Argentine newspapers follows a constantly increasing curve. This pattern parallels the growth of Irish papers and American daily papers over the same period. Due to the lack of complete data for the twentieth century, however, Argentine newspapers are not observed during their decline phase (which does, in fact, occur). Conversely, much of the growth phase is not observed for operating railroads (shown in panel *d*). Data on the automobile industry (Lawrence & Dyer 1983) and national labor unions (Hannan & Freeman, Unpublished work, 1980) also display this pattern. Such an apparently common regularity begs for explanation.

Most of the previous research on the population ecology of organizations has relied on models of multiple populations. Most frequently, these are multivariate extentions of the logistic model (commonly referred to as the Lotka-

[5]Specification of carrying capacity as a function of exogenous variables that vary over time means that the ceiling may never be reached, because it may continually inch ahead of the actual growth rate. Nonetheless, Carroll (1981) and Cafferata (1982) have both advocated nonlinear carrying capacity equations with monotonically decreasing slopes.

Volterra model) and the linear partial-adjustment model (Hummon et al 1975). Although these models assume a functional form for the time trajectory of population growth, this research emphasizes interorganizational relations. The focal point of these models is the so-called competition matrix, which summarizes all relations between organizational forms in a convenient manner; positive signs indicate symbiotic relations, negative signs indicate competitive relations. Measures of the average absolute value of the entries in the matrix have been used to estimate overall competitive intensity (Hannan & Freeman 1978, Carroll 1981).

The use of Lotka-Volterra equations was intially advocated by Hannan & Freeman (1977); however, it was not until Carroll's (1981) study of organizational expansion in national systems of education that the model was implemented in empirical research. Other research using similar models includes a discrete time model of national educational systems (Nielsen & Hannan 1977) and a nonlinear model of physician supply (Rundall & McClain 1982). In an innovative study of the niche dimensions of voluntary organizations, McPherson (1983) has proposed an alternative estimation procedure for the Lotka-Volterra model. This procedure is valuable when temporal equilibrium can be assumed (this is justified in McPherson's case but cannot commonly be assumed) and when detailed data on organizational membership are available.

Community Ecology

FOUNDINGS AND DEATHS The emergence and disappearance of organizational forms fall within the domain of community ecology. Despite the importance of this topic for ecological theory, there is relatively little research on it. The studies that do exist—e.g. Marrett's (1980) examination of the rise of women's medical societies—are not generally tied to ecological theory (for exceptions, see Aldrich & Mueller 1982, Aldrich & Fish 1982). This paucity of research is unfortunate because topics such as competitive exclusion lie at the heart of evolutionary thinking. Moreover, research on the rise and fall of organizational forms seems a natural way to tie organizational ecology into other areas of sociological thought, such as the literature on political revolutions. Such studies can also address the debate over punctuational (Hannan & Freeman 1983) versus graduational (March 1981) images of evolution.

STRUCTURE OF COMMUNITIES Slightly more research has been conducted on the structure of organizational communities. These studies examine the general organizational structure of urban communities (Lincoln 1977a, 1979; Turk 1977), as well as of specific sectors of urban communities such as voluntary organizations (Lincoln 1977b), hospitals (Fennell 1980), funeral homes (Torres 1983), and community service agencies (Galaskiewicz 1979); Astley & Fombrun (1983) have initiated a study of the larger telecommunica-

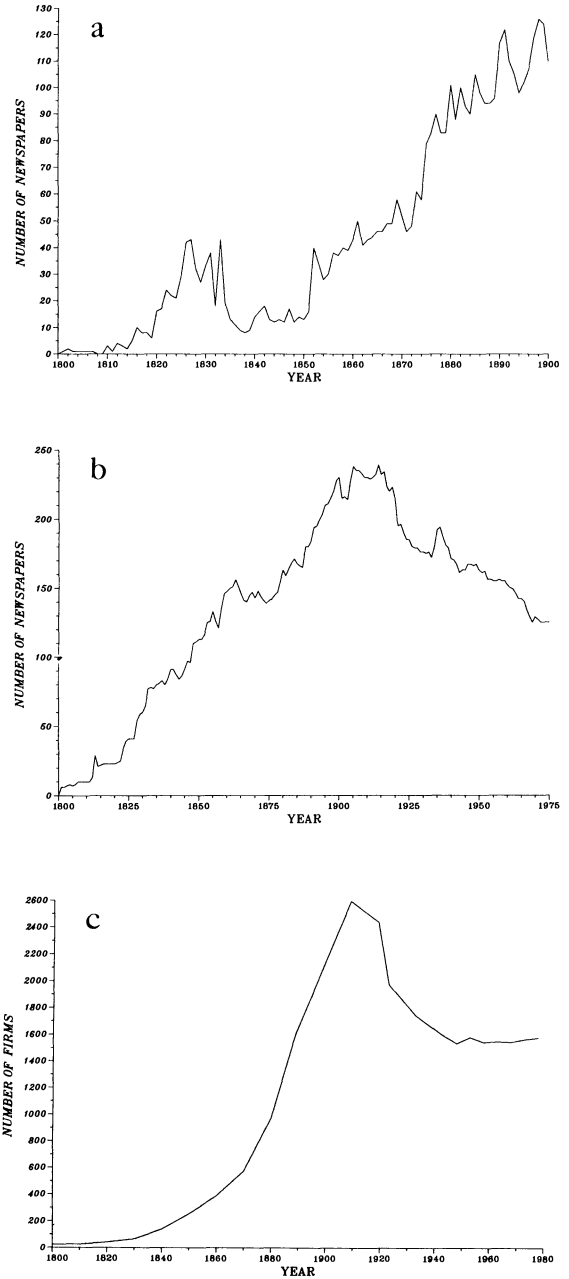

Figure 2 Patterns of change in the size of populations of organizations: (*a*) Argentine newspapers; (*b*) Irish newspapers; (*c*) US daily newspapers.

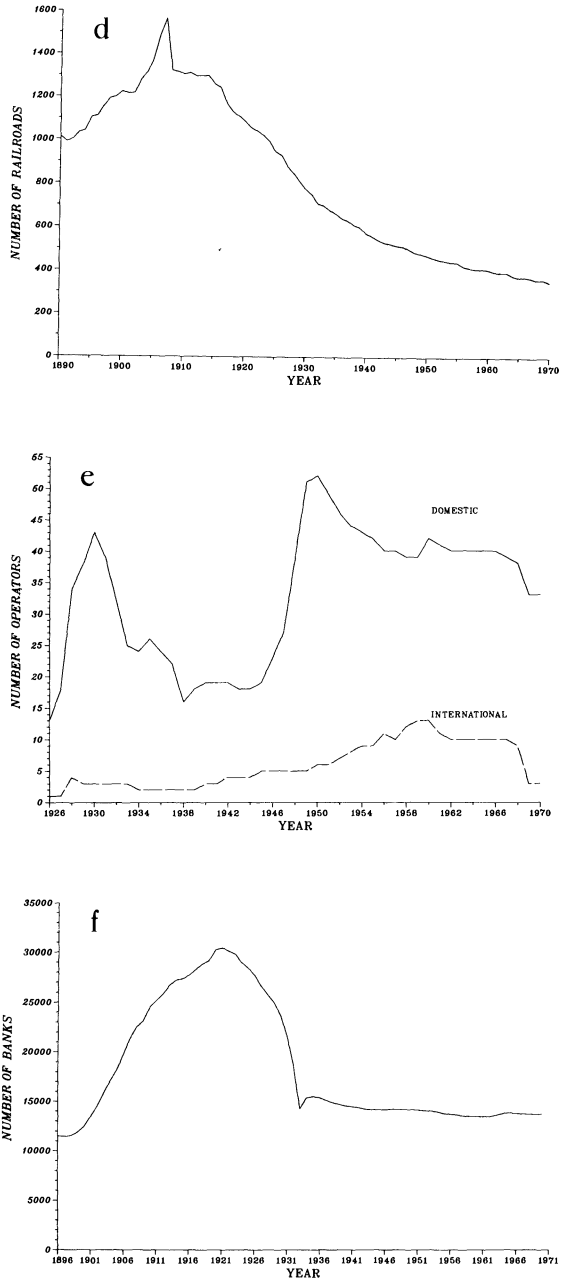

Figure 2 (continued) (*d*) operating railroads; (*e*) scheduled air transportation operators; (*f*) commercial banks.

tions industry. These studies commonly investigate conventional organizational variables such as differentiation and interdependence, but they focus on the community level of analysis. Hannan and Freeman (Hannan 1980; Hannan & Freeman 1983) have proposed research on properties that are unique to communities such as complexity, stability, and dimensionality (see also Fombrun & Astley 1983). These efforts represent an important start in the development of a community ecology of organizations, but until more exploratory research is done, the significant research problems will remain undefined. At present, we have just started to measure and compare the properties of organizational communities.

CONCLUSION

As its many developing perspectives show, organizational theory is an exciting subdiscipline within sociology. Organizational ecology represents but a single perspective, and as such, it competes with others to explain organizational structure and behavior (for comparisons, see Scott 1981, Pfeffer 1982). In many ways, however, the future development of organizational theory depends not on the dominance of one perspective, but on the wedding of the most important insights from various perspectives. Empirical research on the historical development of industries and organizations seems guaranteed to generate such an intermingling of theories.

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Literature Cited

Aldrich, H. 1971. Organizational boundaries and interorganizational conflict. *Hum. Relat.* 24:279–93

Aldrich, H. 1979. *Organizations and Environments*. Englewood Cliffs, NJ: Prentice-Hall

Aldrich, H., Fish, D. 1982. Origins of organizational forms: births, deaths and transformations. Presented at Soc. Sci. Res. Counc. Conf. Soc. Indic., Washington DC

Aldrich, H. E., Mueller, S. 1982. The evolution of organizational forms: technology, coordination, and control. In *Research in Organizational Behavior*, ed. B. M. Staw, L. L. Cummings, 4:33–87. Greenwich, Conn: JAI

Aldrich, H. E., Pfeffer, J. 1976. Environments of organizations. *Ann. Rev. Sociol.* 2:79-105

Aldrich, H. E., Reiss, J. Jr. 1976. Continuities in the study of ecological succession: Changes in the race composition of neighborhoods and their businesses. *Am. J. Sociol.* 81:846–66

Aldrich, H., Stern, R. 1983. Resource mobilization and the creation of U.S. Producers' cooperatives, 1835–1935. *Econ. Ind. Democr.* 4: In press

Amburgey, T. 1983. *Strategy, structure and merger*. PhD thesis. Stanford Univ., Calif.

Astley, W. G. 1980. Review of organizations and environments. *Organ. Stud.* 1:285–88

Astley, W. G., Fombrun, C. J. 1983. Technological innovation and industrial structure: The case of telecommunications. In *Advances in Strategic Management,* Vol. 1, ed. R. Lamb. Greenwich, Conn: JAI. In press

Bergeson, A., ed. 1980. *Sociological Studies of the World System*. New York: Academic

Berry, B. J. L., Kasarda, J. D. 1977. *Contemporary Urban Ecology*. New York: Macmillan

Birch, D. 1979. *The Job Generation Process*. Cambridge, Mass: MIT Program on Neighborhood & Regional Change

Brittain, J., Freeman, J. 1980. Organizational proliferation and density-dependent selection. In *Organizational Life Cycles,* ed. J. Kimberly, R. Miles, pp. 291–338. San Francisco: Jossey-Bass

Burgess, E. W. 1925. The growth of the city: An introduction to a research project. In *The City,* ed. R. E. Park, E. W. Burgess, R. D. McKenzie, pp. 47–62. Chicago: Univ. Chicago Press

Cafferata, G. L. 1982. The building of democratic organizations: An embryological metaphor. *Admin. Sci. Q.* 27:280–303

Campbell, D. 1969. Variation and selection retention in sociocultural evolution. *Gen. Syst.* 16:69–85

Carroll, G. R. 1981. Dynamics of organizational expansion in national systems of education. *Am. Sociol. Rev.* 46:585–99

Carroll, G. R. 1983. A stochastic model of organizational mortality: Review and reanalysis. *Soc. Sci. Res.* 12:303–29

Carroll, G. R. 1984. *Publish and Perish: A Dynamic Analysis of Organizational Mortality in the Newspaper Industries of Argentina, Ireland and the United States*. Greenwich, Conn: JAI

Carroll, G. R., Delacroix, J. 1982. Organizational mortality in the newspaper industries of Argentina and Ireland: An ecological approach. *Admin. Sci. Q.* 27:169–98

Casstevens, T. 1980. Birth and death processes of government bureaus in the United States. *Behav. Sci.* 25:161–65

Child, J., Kieser, A. 1981. Development of organizations over time. In *Handbook of Organizational Design,* Vol. 1, ed. W. H. Starbuck, P. C. Nystrom. London: Oxford Univ. Press

Churchill, B. C. 1955. Age and life expectancy of business firms. *Surv. Curr. Bus.* 35:15–19

Council for Private Post-Secondary Education Institutions. 1983. *Chief's Report*. Sacramento, Calif: Calif. State Dep. Educ.

Delacroix, J., Carroll, G. R. 1983. Organizational foundings: An ecological study of the newspaper industries of Argentina and Ireland. *Admin. Sci. Q.* 28:274–91

Dun & Bradstreet. 1978. *The Failure Record*. New York: Dun & Bradstreet, Inc., Ind. Stud. Dep.

Duncan, B., Lieberson, S. 1970. *Metropolis and Region in Transition*. Beverly Hills, Calif: Sage

Duncan, O. D. 1964. Social organization and the ecosystem. In *Handbook of Modern Sociology,* ed. R. E. L. Faris, pp. 37–82. Chicago: Rand McNally

Duncan, O. D., Schnore, L. F. 1959. Cultural, behavioral and ecological perspectives in the study of social organization. *Am. J. Sociol.* 65:132–46

Epstein, R. C. 1927. The rise and fall of firms in the automobile industry. *Harv. Bus. Rev.* 2:157–74

Fennell, M. 1980. The effects of environmental characteristics on the structure of hospital clusters. *Admin. Sci. Q.* 25:485–510

Fombrun, C. J., Astley, W. G. 1983. The structural evolution of the telecommunications community. *Proc. 43rd Ann. Meet. Acad. Mgmt., Dallas,* pp. 246–50

Freeman, J. 1981. Review of organizations and environments. *Am. J. Sociol.* 86:1447–50

Freeman, J. 1982. Organizational life-cycles and natural selection processes. See Aldrich & Mueller 1982, pp. 1–32

Freeman, J., Brittain, J. W. 1977. Union merger process and industrial environment. *Ind. Relat.* 2:173–85

Freeman, J., Carroll, G. R., Hannan, M. T. 1983. The liability of newness: Age dependence in organizational death rates. *Am. Sociol. Rev.* 48:692–710

Freeman, J., Hannan, M. T. 1983. Niche width and the dynamics of organizational populations. *Am. J. Sociol.* 88:1116–45

Galaskiewicz, J. 1979. *Exchange Networks and Community Politics*. Beverly Hills, Calif: Sage

Granovetter, M. 1979. The idea of "advancement" in theories of social evolution and development. *Am. J. Sociol.* 88:489–515

Greiner, L. E. 1972. Evolution and revolution as organizations grow. *Harv. Bus. Rev.* 50 (4):37–46

Hannan, M. T. 1980. *The Ecology of National Labor Unions: Theory and Research Design, Tech. Rep. No. 1*. Org. Stud. Sect., Inst. Math. Stud. Soc. Sci., Stanford Univ., Calif.

Hannan, M. T., Freeman, J. 1977. The population ecology of organizations. *Am. J. Sociol.* 82:929–64

Hannan, M. T., Freeman, J. 1978. Internal politics of growth and decline. In *Environments and Organizations,* ed. M. Meyer, pp. 177–99. San Francisco: Jossey-Bass

Hannan, M. T., Freeman, J. 1983. *Structural inertia and organizational change, Tech. Rep. No. 5,* Organ. Stud. Sect., Inst. Math.

Stud. Soc. Sci., Stanford University, Stanford, Calif.
Harris, M. 1977. *Cannibals and Kings: The Origins of Cultures*. New York: Random
Harris, M. 1979. *Cultural Materialism: The Struggle for a Science of Culture*. New York: Random
Hawley, A. 1950. *Human Ecology*. New York: Ronald
Hawley, A. 1968. Human ecology. In *International Encyclopaedia of the Social Sciences*, ed. D. Sills, pp. 328–37. New York: Macmillan
Hawley, A. 1971. *Urban Society*. New York: Ronald
Hawley, A. 1978. Cumulative change in theory and history. *Am. Sociol. Rev.* 43:787–96
Heilman, F. A. 1935. *Mortality of Business Firms in Minneapolis, St. Paul and Duluth, 1926–30, Stud. Econ. & Bus.*, Univ. Minn.
Hummon, N. P., Doreian, P., Teuter, K. 1975. A structural control model of organizational change. *Am. Sociol. Rev.* 40:812–24
Kasarda, J. D., Bidwell, C. E. 1984. A human ecological theory of organizational structuring. In *Sociological Human Ecology*, ed. M. Micklin, H. M. Choldin. New York: Academic. In press
Kaufman, H. 1975. The natural history of organizations. *Admin. Soc.* 7:131–49
Kaufman, H. 1976. *Are Government Organizations Immortal?* Washington DC: Brookings
Kimberly, J. R. 1975. Environmental constraints and organizational structure: a comparative analysis of rehabilitation organizations. *Admin. Sci. Q.* 20:1–9
Kimberly, J. R., Miles, R. H., eds. 1980. *The Organizational Life Cycle*. San Francisco: Jossey-Bass
Lawrence, P., Dyer, D. 1983. *Renewing American Industry*. New York: Free
Lenski, G. E., Lenski, J. 1974. *Human Societies: A Macro Level Introduction to Sociology*. New York: McGraw-Hill
Lincoln, J. R. 1977a. Organizational dominance and community structure. In *Power, Paradigms and Community Research*, ed. R. J. Liebert, R. W. Imershein, pp. 19–50. London: Sage
Lincoln, J. R. 1977b. The urban distribution of voluntary organizations. *Soc. Sci. Q.* 58: 472–80
Lincoln, J. R. 1979. Organizational differentiation in urban communities: A study in organizational ecology. *Soc. Forc.* 57: 915–29
March, J. G. 1981. Footnotes on organizational change. *Admin. Sci. Q.* 26:563–97
Marple, D. 1982. Technological innovation and organizational survival: A population ecology study of nineteenth-century American railroads. *Sociol. Q.* 23:107–16
Marrett, C. B. 1980. Influences on the rise of new organizations: The formation of women's medical societies. *Admin. Sci. Q.* 25:185–99
McKelvey, B. 1975. Guidelines for the empirical classification of organizations. *Admin. Sci. Q.* 20:509–25
McKelvey, B. 1978. Organizational systematics: Taxonomic lessons from biology. *Mgmt. Sci.* 24:1428–40
McKelvey, B. 1982. *Organizational Systematics*. Berkeley: Univ. Calif. Press
McKelvey, B., Aldrich, H. 1983. Populations, natural selection, and applied organizational science. *Admin. Sci. Q.* 28:101–28
McKenzie, R. D. 1924. The ecological approach to the study of the human community. *Am. J. Sociol.* 30:287–301
McKenzie, R. D. 1926. The scope of human ecology. *Am. J. Sociol.* 32:141–54
McPherson, M. 1983. An ecology of affiliation. *Am. Sociol. Rev.* 48:519–32
Miles, R. H. 1982. *Coffin Nails and Corporate Strategies*. Englewood Cliffs, NJ: Prentice-Hall
Nielsen, F., Hannan, M. T. 1977. The expansion of national educational systems: Tests of a population ecology model. *Am. Sociol. Rev.* 42:479–90
Park, R. E. 1923. The natural history of the newspaper. *Am. J. Sociol.* 29:273–89
Park, R. E. 1926. The urban community as a spatial pattern and a moral order. In *The Urban Community*, ed. R. E. Park, E. W. Burgess, R. D. McKenzie. Chicago: Univ. Chicago Press
Park, R. E. 1929. *The Immigrant Press and Its Control*. New York: Harper
Pennings, J. M. 1982. Organizational birth frequencies: An empirical investigation. *Admin. Sci. Q.* 27:120–44
Perrow, C. 1979. *Complex Organizations: A Critical Essay*. Glenview, Ill: Scott Foresman. 2nd ed.
Pfeffer, J. 1982. *Organizations and Organization Theory*. Boston: Pitman
Phillips, A. 1971. *Technology and Market Structure*. Lexington, Mass: Heath
Pianka, E. C. 1978. *Evolutionary Ecology*. New York: Harper & Row
Pred, A. 1966. *The Spatial Dynamics of U. S. Urban-Industrial Growth, 1800–1914*. Cambridge, Mass: MIT
Pred, A. 1975. On the spatial structure of organizations and the complexity of metropolitan interdependence. *Pap. Reg. Sci. Assoc.* 35:115–42
Roughgarden, J. 1979. *Theory of Population Genetics and Evolutionary Ecology: An Introduction*. New York: Macmillan

Rundall, T. G., McClain, J. O. 1982. Environmental selection and physician supply. *Am. J. Sociol.* 87:1090–1112
Sahlins, M., Service, E., eds. 1960. *Evolution and Culture*. Ann. Arbor: Univ. Mich. Press
Scott, W. R. 1975. Organizational structure. *Ann. Rev. Sociol.* 1:1–20
Scott, W. R. 1981. *Organizations: Rational, Natural and Open Systems*. Englewood Cliffs, NJ: Prentice-Hall
Skocpol, T. 1977. Wallerstein's world capitalist system: A theoretical and historical critique. *Am. J. Sociol.* 82:1075–90
Stanley, S. M. 1979. *Macroevolution*. San Francisco: Freeman
Starbuck, W. H., Nystrom, P. C. 1981. Designing and understanding organizations. See Child & Kieser 1981, pp. ix–xxii
Stearns, T. 1982. *Environmental variation and strategic behaviors: conditions for survival in the television station industry*. Presented at 42nd Ann. Meet. Acad. Mgmt., New York
Stinchcombe, A. L. 1965. Social structure and organizations. In *Handbook of Organizations*, ed. J. G. March, pp. 142–93. Chicago: Rand-McNally
Tewksbury, D. G. 1932. *The Founding of American Colleges and Universities before the Civil War*. New York: Columbia Univ. Teach. Coll.
Thomas, P. R. 1977. *An Analysis of the Pattern of Growth of the Automobile Industry 1895–1930*. New York: Arno
Torres, D. 1983. *An industry and its environment*. PhD thesis. Northwestern Univ., Evanston, Ill.
Turk, H. 1970. Interorganizational networks in urban society: initial perspectives and comparative research. *Am. Sociol. Rev.* 35:1–19
Turk, H. 1977. *Organizations in Modern Life*. San Francisco: Jossey-Bass
Ulrich, D. 1983. *United States and Japanese electronics industries: taxonomy and selection*. See Fombrun & Astley 1983
US Bureau of the Census. 1975. *Historical Statistics of the United States*. Washington DC: USGPO
US Department of Labor. 1976. *Employment and Wages First Quarter 1975*. Washington: Bur. Labor Stat.
US Federal Deposit Insurance Corporation (FDIC). Various Years. *National Summary of Accounts and Deposits in all Commercial Banks*. Washington DC:FDIC
US Federal Reserve. 1959. *All-Bank Statistics, United States, 1896–1955*. Washington DC: Board of Governors Fed. Reserve Syst.
US Small Business Administration. 1983. *The State of Small Business: A Report of the President*. Washington DC:USGPO
University of California. Various Years. *Blue and Gold* (Yearbook). Berkeley: Univ. Calif.
Van de Ven, A. 1979. Review of organizations and environments. *Admin. Sci. Q.* 24:320–26
Wallerstein, I. 1974. *The Modern World System: Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century*. New York: Academic
Warren, R. 1967. The interorganizational field as a focus for investigation. *Admin. Sci. Q.* 12:396–419
Warriner, C. K. 1977. *Empirical taxonomies and the comparative study of organizations*. Presented at Ann. Meet. Am. Sociol. Assoc., Chicago
Whetten, D. 1980. Sources, responses and effects of organizational decline. See Kimberly & Miles 1980, pp. 342–74
Zelditch, M. Jr. 1969. Can you really study an army in the laboratory? In *A Sociological Reader on Complex Organizations*, ed. A. Etzioni, pp. 528–39. New York: Holt, Rinehart & Winston. 2nd ed.