PART II—DELIMITING STOCHASTIC IDIOSYNCRASY: PHASE STATES OF ADAPTIVE PROGRESSION, METABOLIC RATES, AND LEVELS OF PREDICTABILITY

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***I wish to thank ...... for many helpful comments. All remaining errors are my responsibility.**

I. INTRODUCTION

In Part I, McKelvey (1995b) characterizes organization science as beset by two infections, *Sci. multidiparadigmaticus* and *Org. idiosyncraticus*. Literature debates between Pfeffer (1982, 1992) and Perrow (1994) illustrate that the *S. multi.* illness prevails in organization theory and Camerer (1985) and Mahoney (1993) signify that it also permeates the strategy literature. McKelvey and Mosakowski argue that *S. multi.* is largely caused by *O. idio*. To the extent that *O. idio*. prevails, the fundamental dilemma is that it seems impossible to simultaneously accept the existence of idiosyncratic organizational phenomena while at the same time also holding to the essential elements of justification logic defined by scientific realism—prediction, generalization, and falsification—which require nonidiosyncratic phenomena (Hempel, 1965; Suppe, 1977, 1989; Hunt, 1991).

In McKelvey (1995b), I first attack the idiosyncrasy problem via ***idiosyncrasy translation*** by focusing scientific measures and interfirm comparisons on the *intended comparability of intermediate outcomes* as proxies rather than on underlying idiosyncratic processes, resources, dynamic capabilities, and so forth. Also in Part I, I deal with the dilemma via ***vertical idiosyncrasy absorption*** by building on Cohen and Stewart's (1994) concept of *contextually emergent simplicity*, Sommerhoff's (1950) concept of *directive correlation* and Hempel's *deductive-statistical* (D-S) model of predictability. In this paper, Part II, I focus on ***horizontal delimitation of idiosyncrasy***, which also translates idiosyncrasy into phenomena conforming to Hempel's (1965) D-S model. Different ***phase states***[1] ***of adaptive progression*** are defined, depending on the strategic approach taken, which delimit the different energy levels required to adapt value chain competencies to changing niches. This approach suggests that predictability models and ensuing scientific methods differ across the various energy levels of organizational phenomena.

After a brief reprise of key ideas from Part I, I develop the idea of adaptive progression by elaborating on coevolution, adaptive energy, and phase states. Then, ways in which phase states delimit the effects of idiosyncrasy and foster translations of idiosyncratic phenomena into more predictable phenomena are discussed. Following this, a phase state research agenda in the form of preliminary research questions is suggested. The paper ends with a redefinition of organization science in terms of idiosyncrasy absorption, phase state delimitations of idiosyncrasy, and the precepts of scientific realism. I conclude that organization science parallels other more advanced sciences in being monoparadigmatic, though encompassing different models of explanation.

II. PART I REPRISE

Part II builds on a number of ideas developed in Part I, briefly reviewed below.

Value Chain Idiosyncrasy. McKelvey (1995b) subsumes the several variants of the "resource-based view" (RBV) (Wernerfelt, 1984; Barney, 1991), "core competence" (Prahalad and Hamel, 1990), and "dynamic capabilities" (Teece, Pisano, and Schuen, 1994) under the RBV label. RBV identifies *scarce* and *valuable* resources as leading to economists' "rents." Porter (1985: 38, 120, 121) also observes that for value chain activities to have value they should be distinct or unique. Thus, both RBV and Porterian schools of strategy now focus on idiosyncratic firm effects. McKelvey (1995b) discusses underlying process/event sequences and overlaying coevolutionary processes as additional sources of chain idiosyncrasy. They subsume all RBV terms, such as

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[1] A phase state, or space, is defined by physicists as representing different levels of quantum excitation or different momentum levels of particles, such as in solid, liquid, or gaseous states. As used here, a phase state represents fundamentally different kinds of

"resources," "core competencies," and "dynamic capabilities," and Porter's "value chain activities" into one term, ***competencies***.

Scientific Realism. Scientific realists emphasize the following points:

1. A theory is a systematically related set of statements, including some lawlike generalizations, that is empirically testable (Rudner, 1966: 10).
2. The purpose of theory is to increase scientific understanding through a systematized structure capable of both explaining and predicting phenomena (Hunt, 1991: 149).
3. And, scientific progress (Hunt, 1991: 293 drawing on Popper and logical empiricism) follows from:
   a) The development of new theories for phenomena not previously explained,
   b) The falsification of existing theories and their replacement with new theories,
   c) The expansion of the scope of a theory to include new phenomena, and
   d) The reduction of specific theories into more general theories.

The fundamental problem is how to practice scientific realist method (including prediction, generalization, and falsification) without ignoring its incompatibility with firms' idiosyncrasies?

Predictability Levels. Organization scientists typically state propositions in the form of Hempel's (1965) *deductive-nomological* (D-N) model of explanation: IF CONDITIONS *C* EXIST, AND COVERING LAWS *L* APPLY, *C* ALWAYS CAUSES *E*. Due to measurement error and other random effects, they typically hope for results in the form: STARTING WITH CONDITIONS *C*, *E* HAS BEEN FOUND, THOUGH CLOUDED BY STATISTICAL FLUCTUATIONS, which Brody (1993) labels the *statistical fluctuation* (S-F) model. Both of these models are falsifiable. Organization scientists usually get results in the form of Salmon's (1971) *statistical-relevance* (S-R) model: STARTING WITH CONDITIONS *C*, *E* HAS BEEN FOUND AT A PROBABILITY OF OCCURRENCE SLIGHTLY HIGHER THAN CHANCE (with minimal variance explained). This model is not falsifiable. Part I concludes that Hempel's *deductive-statistical* (D-S) model is more useful for organization scientists than the D-N or S-R models. The D-S model follows the D-N model, except that what is predicted is not an event but rather a probabilistic distribution of events,

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competitive energy, each state having different energic properties, and separated by phase transition phenomena.

thus: IF CONDITIONS C EXIST, AND COVERING LAWS L APPLY, C ALWAYS CAUSES STATISTICAL DISTRIBUTION D. This model is also falsifiable.

In Part II, I also use Hempel's *inductive-statistical (I-S) model*. In the I-S model, E IS NOT A DETERMINED CONSEQUENCE OF C, BUT IS "ALMOST CERTAINLY, WITH HIGH PROBABILITY, VERY LIKELY" TO OCCUR (Hempel, 1965: 382), but neither a specific event nor a specific probability distribution is predicted. What does "highly likely" mean? Hempel holds out for an "almost certain" likelihood. Hunt (1991) does not explicitly specify a probability level, though in his one example (p. 61) he uses a 90% figure. I-S models may be weakly falsifiable.

Directive Correlation. Supposing an environmental shock causes a need to adapt in a group of coevolving firms, in directive correlation analysis (Sommerhoff, 1950), the shock is the initiating event, termed the ***cœnetic variable*** (CV_{t0}); firms pursue different ***responses***, R_{1t1}, R_{2t1}, R_{3t1}, R_{4t1}, etc., in trying to approach the ***focal condition*** (FC) (the adaptive target), which may also be changing as the competitive system coevolves; firms also encounter **environmental constraints** in the competitive context, E_{1t1}, E_{2t1}, E_{3t1}, E_{4t1}, in trying to reach the FC. In Part I, McKelvey (1995b) identifies DC envelopes as defined by the CVs and ***intendedly comparable***[2] FCs of each adapting firm. Inside a firm's ***DC envelope***, its ***DC system*** comprises all of the Es and Rs appearing as the firm attempts to move toward the FC. Via envelope and system analysis, a portion of a firm's idiosyncratic behavior is translated into behavioral outcome "pressure" streams and "parameters" governing solution approaches within DC systems that, the authors hypothesize, have predictable statistical regularities (termed ***SR-distributions***) in the form of the D-S model.

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[2] Intended comparability (Mosakowski and McKelvey, 1995) occurs when two competitors adopt the same adaptive progression target, such as increased disk capacity in the laptop example, or underlying value chain competencies leading to improved disk capacity, reliability or service, etc., even though in each example the specific processes in each firm remain idiosyncratic.

III. COEVOLUTIONARY ADAPTIVE PROGRESSION

In this section I develop the main theoretical components underlying my approach to delimiting idiosyncrasy in support of scientific realist method. First, the adaptive progression of firms in coevolutionary competitive systems is discussed. Then coevolutionary competition at the "parts" level of firms is introduced. Finally, I define five phase states of adaptive progression.

A. COEVOLUTIONARY NICHE THEORY

"The true and stunning success of biology reflects the fact that organisms do not merely evolve, they *coevolve* both with other organisms and with a changing abiotic environment (Kauffman, 1993: 237; his emphasis). Coevolution is a topic of growing interest in the study of firms. Porter (1990, 1991) identifies coevolutionary pockets as a possible basis of the competitive advantage of nations. Organization scientists now study coevolution at community, firm, and intrafirm levels (Astley, 1985; Barnett, 1994; Baum and Singh, 1994b; Brittain, 1994; Rosenkopf and Tushman, 1994; and Van de Ven and Garud, 1994). Descriptions of organizational environments have shifted from early characterizations in terms of uncertainty, complexity, and munificence, to attributes such as graininess, fitness sets, and more generally, niche theory (Aldrich, 1979; Brittain and Freeman, 1980; McKelvey, 1982; Hannan and Freeman, 1977, 1989; Baum and Singh, 1994a; Brittain, 1994). In the biological world, changes because of abiotic forces, such as new lakes and mountains, changes in climates, or cataclysms, are rare relative to coevolutionary changes coupled to niche resources and other biological organisms. Supposing that the same is true for firms, that evolutionary forces such as changes in types of socio-economic structure or physical and biological principles underlying technology are rare relative to coevolutionary niche events, organizational evolutionists and ecologists may have spent the last two decades studying the tip of the iceberg, leaving the more telling theory of firm coevolution underdeveloped.

Ecological niches are defined as follows:

1. A niche is the "sum total of the adaptations of an organismic unit" (Pianka, 1994a: 269). It coevolves as a population changes resource consumption capabilities.
2. A niche traditionally has been defined by ecologists in terms of the resources consumed by the resident organism (Hutchinson, 1957; Levins, 1968; MacArthur, 1972). Thus a niche is defined by the competencies a firm has available for harvesting from the ***resource pool*** comprising its niche.
3. While elements of a firm's niche are subject to manipulation as it develops relevant competencies, aspects of the broader environment, for all practical purposes, are not (Odum, 1971, 1993; McKelvey, 1982: 109).
4. The resource pool of a niche is subject to change by events in addition to the behavior of its inhabitants, such as changing economic, technological, political and social elements.
5. The resource pool must be both available and within a firm's competence for harvesting, to serve as the source of revenues critical to the long run survival and sustainable competitive advantage the firm.
6. Resource pools coevolve with the emergence of organizational forms suited for harvesting the resource.
7. Each niche may contain other competitors who have also evolved along with the target firm and are able to compete more or less effectively for the resource.

The foregoing view of ecological coevolution recognizes the fundamental interdependency between the nature of firms and the nature of the niche resources available for harvesting—each changes as the other changes (Erlich and Raven, 1964; Smith, 1970; Feeny, 1975; Futuyma and Slatkin, 1983; Thompson, 1989; and Nelson, 1994). Three key elements of coevolution are highlighted, 1) firm vs. niche resource link; 2) firm vs. competition link; and (3) <u>non</u>coevolutionary resources and constraints in the context of which firms evolve, such as physical and biological laws, geographical spaces, population dynamics, large-scale socio-economic forces, and so on.

B. MULTICOEVOLUTIONARITY

Books giving overviews of coevolutionary studies in biology (Nei, 1987; Kauffman, 1993; Cohen and Stewart, 1994), clearly indicate that coevolutionary effects may be studied at virtually all levels in biological organisms, DNA molecules, proteins, chromosomes, cells, limbs and organs, traits, and whole organisms. Entities at all these levels may also be seen as surviving or not surviving. Thus, coevolution is *mostly* studied at "parts" levels. A perspective developed in McKelvey (1995a) and McKelvey (1995b) is that organizational coevolution also occurs at various "parts" levels of firms. As RBV scholars and Porter have introduced firm[3] effects, they both have also introduced the idea that firms: (1) May compete on each competence of the value chain; (2) May achieve idiosyncrasy and consequent rents via one or more chain competencies; but (3) May also compete one or more of them down to marginality. It follows that economists' traditional view of firms competing on prices, and ecologists' views of firm survival or failure, result from an aggregated competition across a variety of chain competencies. For example, laptop computer firms compete on competencies underlying primary chain components, such as: drive size and speed, chip capability, heat sinks, ease of upgrading; and support chain elements, such as: reliability, speed of delivery, support telephone response, and so forth.

In Part I, McKelvey (1995b) recognizes that idiosyncrasy absorption may occur at several levels in firms. There may also be several levels of parts at which coevolution takes place. For now, we limit our analysis to value chain competencies as the parts of concern. Needless to say, even in small firms there are a considerable number of distinct primary and support chain competencies, as the laptop example indicates. ***Multicoevolutionarity*** occurs when firms simultaneously compete on two or more coevolutionary chain competencies.

C. PHASE STATES OF ADAPTIVE PROGRESSION

Given multicoevolutionarity, firms may experience adaptive progression on any number of chain competence "parts." It is possible that the "pace" of adaptive progression may differ across parts. Coevolution may speed along on, say, on competencies pertaining to memory capacity but lag on those underlying battery life. Or, pace on one competence may speed along because there are a number of sophisticated coevolutionary opponents while lagging on some other competence because a firm may enjoy patent protection, and so forth. From this point on, **I wish to stress that adaptive progression pertains to "parts" of firms, not firms as "wholes**."

1. Organizational Transformational Energy

One of the wonderful arguments about dinosaurs is whether they are homeothermic or poikilothermic[4] and bird-hipped or lizard-hipped. The Jurassic Park movie took the view that dinosaurs are homeothermic and bird-like, though not everyone agrees. Reality aside, the entertainment value of the film soared because *'raptors* and *T. rexes* moved at ostrich rather than iguana paces. The argument is fundamentally about energy transformation. Lizards and snakes can go into a virtual metabolic stasis and live for months without energy intake or use while birds, in contrast, live at a very high metabolic rate (Pianka, 1994b). Organisms do not gain or lose energy—they simply use chemical reactions to translate it from one form into another, say, from sunlight, sugar, and soil nutrients into proteins. Biologists have a global term, "metabolism," that refers to the rate at which chemical reactions take place. Cells include "pacemaker" enzymes that control the rate of metabolism. Further, the rate of enzymatic (metabolic) reaction may be speeded up or slowed down by "regulatory metabolites." So much for dino metabolism!

Organizational evolutionary theory comes in gradualist and punctuationist forms (Aldrich, 1979; Hannan and Freeman, 1977, 1989; McKelvey, 1982; Miller and Freisen, 1984; Tushman and Romanelli, 1985; Tushman and Anderson, 1986; Romanelli and Tushman, 1994). Recently

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[3] Defined as an individual single business unit, whether independent or a division of a corporation.

[4] Homeotherms (birds, mammals) produce heat internally by means of oxidative metabolism. Poikilotherms (snakes, lizards) obtain it from the environment. The latter may also be warm-blooded, depending on how much external heat they absorb.

attention has focused on how and why the pace of organization change changes (Gersick, 1994; Eisenhardt and Tabrizi, 1995). Given the second law of thermodynamics, firms cannot create or destroy energy, they can only translate it from one form to another. One can think of "pace" as 1) how fast the primary value chain translates input energy into output energy and 2) how fast the support chain adapts the firm from one energy transformation system to another. Experience suggests that both kinds of energy translation are inextricably intertwined—the primary chain cannot continue as an optimal energy translation system without staying adapted to a changing niche and adaptive progression cannot persist without being energized by the primary chain. In this view, firms with low energy primary chains cannot host support chains conducting high energy adaptive progression, and high energy support chains cannot long persist given low energy primary chains, that is, energy transformation rates in primary and support chains have to be compatible.

Organizational energy transformation rates appear, and are controlled in many ways: worker motivation levels, financial planning horizons, inventory "turns," product production cycles, product development cycles, seasonal changes, academic calendars, promotion intervals, holiday buying cycles, *r* and *k* type strategies and associated environments, and so on. Walk into a post office and it seems like a time warp—everything moves at half speed. Universities work leisurely on an annual cycle—everything seems paced at this schedule. Production "shoots" for TV episodes run on one week cycles. Japanese develop and produce cars in half the time it takes Germans. Some firms run like beehives while others feel like morgues.

There are countless ways organizational competencies transform financial, material, and individual worker "energy" from inputs into outputs. There are also many ways in which firms alter competencies to adapt them to changing niches. At the individual competence level, both processes can run at slow or rapid paces, that is, low or high energy levels. Organization scientists do not seem to have a global term, such as "metabolism," to refer to the overall rate at which a competence might transform energy. The term, metabolism (meaning *change*), appears to be a biological term. In fact it was first used in 1773 outside of biology to mean *transition*—the first biological usage was not until 1839 (Simpson and Weiner, 1989: Vol. IX: 664). Taking advantage of nonbiological precedence, my focus is on firms' ***metabolic rates of energy transformation***.

2. DELIMITING METABOLIC PHASE STATES

Given competence multicoevolutionarity and firm metabolic rates, I can now discuss rates of change in value chain competencies in terms of ***phase states of adaptive progression***. Adaptive progression in chain competencies may be typologized as five different phase states, each requiring different energy demands. Each state may show a range of energies, but there also appear to be significant demarcations separating them. The five states exist in a hierarchical relation, as follows: ***Alpha***, ***Beta***, ***Gamma***, ***Delta***, and ***Zeta***[5]. The order is based on metabolic rates, with the Alpha state having the lowest and the Zeta state requiring the highest metabolic rate to keep operating, loosely analogous to the five states of physical matter (approaching absolute zero, solid, liquid, gaseous, and plasmas of exploding gases). Furthermore, phase state *transitions* (from one state to another) may show energy peaks (gains or losses), whereas the different metabolic rates within a particular state—to be more or less coevolutionary or more or less idiosyncratic—most likely are lower than transition peaks.

In typologies a few "essential" attributes define each type (McKelvey, 1982), as shown in Figure 1. The essential attributes here emerge from strategic competition. Firms may move in or out of adaptive phase states via intentional or unintentional changes in competitive behavior. Firms may also be moved into or out of a state by the behaviors of competing firms, or other exogenous events such as changing technology. In my conception, firms mostly intentionally "jump" to higher levels and "fall" to lower levels. "Falling" seems more uniformly distributed between intentional and unintentional events, given the likelihood that raising metabolic rate (by allocating resources, focus, intensity, and effort) is more difficult than lowering it.

Insert Figure 1 about here

Are metabolic rate differences continuous or delimited into phase states? My answer is that the different essentialist elements shown in Figure 1 cause discontinuity. Mimetic behavior is demonstrably discontinuous from leap-frogging coevolutionary behavior. Behavior focused on opaqueness and barrier formation is demonstrably different from coevolutionary behavior. Leaping life-cycles is demonstrably different from idiosyncrasy or within product coevolution. Agreed, firms are not simply locked or changing—there may be a continuous change in energy devoted to adaptive progression, from absolutely none to some. But the discontinuity between varying amounts of possible adaptive change in the Alpha state and behavior focused on achieving best practice seems clear. Phase states are identified by the criteria in Figure 1, not by metabolic discontinuities. States are discontinuous because the focus of the energy is on clearly different objectives, not because there are obvious breaks in energy use, absent anything else. But once identified, my hypothesis is that the average metabolic rates differ substantially from one phase state to another, and increase, going from the Alpha state to the Zeta state, because the metabolic requirements of each state differ substantially.

3. ALPHA PHASE STATE

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[5] I tried experimenting with more mnemonic labels but they were cumbersome and hokey, with some overlap in meaning.

Locked. An *Alpha* phase state occurs when a firm makes no progressive movement toward adaptation on a particular competence of its value chain, though there could be random movements which have no consistent adaptive purpose. Evidence of Alpha is *no change* in the competence under consideration. Minimal metabolic rate could be due to a strategic wish not to change, inertial forces preventing change, lack of coevolutionary pressure, or simply lack of concern.[6] This state seems to be the starting point for many organization development, sociotechnical systems, TQM, and reengineering approaches to organizational adaptation (French, Bell, and Zawacki, 1994).

4. BETA PHASE STATE

Best Practices Mimicry. In the *Beta* phase state a firm finds itself lagging in its industry on one or more chain competencies and undertakes a program of progressing toward known best practice. The key definitional attributes here are *known* and *best practice*. A firm may find out what are best practices from its industry association, by copying other firms' overt behaviors—what is commonly termed "benchmarking" (Camp, 1989; Spendolini, 1992; Watson, 1993; Boxwell, 1994), or by beginning an intelligence or personnel raiding campaign to learn what good firms seem to be doing to survive in the industry. In the quick print industry there is a published book of best practices (Hunt, 1988). In some industries, such as quick printing, known best practices could cover most of the essential value chain competencies. In other newer industries, involving complicated technology, changing customer demands, and new management methods, there may be few known best practices.

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[6] Whether a firm can really "choose" to remain unresponsive is an interesting question. The Slade Case (a Harvard classic) is a good example an informal work group choosing to adapt to changing conditions even though management remained oblivious to what was happening inside and outside the firm.

In best practice benchmarking, a firm does not try to adapt to a new environment or try to achieve rents. It simply tries to bring its methods up to date by mimicking competitors. Typically these firms are in the Alpha state trying to jump to the higher metabolic rate required to achieve best practice. Examples of ongoing transition attempts at Conrail, Bell South, CEMEX, Chemical Bank, and US Postal Service were recently presented by Mottur and Associates (1995). Jumping into, and staying in the Beta state is a low risk/low gain approach, since the adaptive targets are known, but successful achievement only leads to survival at a marginal rate of return. There is modest downside risk, since any attempt at change may go wrong at some expense to the firm and thus might raise the likelihood of failure (Hannan and Freeman, 1984).

5. Gamma Phase State

Multicoevolutionary Leap-frogging *Within* Product Life-cycles. The *Gamma* phase state is defined by DC envelope attributes when intendedly comparable *FC*s define a coevolutionary system of firms. In these instances of adaptive progression, firms reach beyond best practice, that is, beyond known solutions to existing industry conditions. The Gamma state is defined when: (1) *FC*s are specific and concrete (laptop makers competing on chip speed competence, or battery life competence, for example); (2) Whether one or another firm is pursuing them is a knowable condition; (3) Whether they are intendedly comparable is discoverable. Firms in this state conclude that survival in the future, or economic rents,[7] or both, call for innovative improvements of competitors' competencies—this is a *leap-frogging* of product related competence. These firms successively push the edges of known practice in new directions until convergence on a new best practice (the Beta state) is reached.

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[7] Mosakowski and McKelvey (1995) discuss conditions under which economic rents are possible.

Once an *FC* is selected that is intendedly comparable, the adaptive target is substantially defined by what other competing firms are trying to accomplish, which is to say, intendedly comparable *FC*s coevolve. This is a difficult task for firms in that they are simultaneously trying to, 1) adapt to novel environmental conditions, 2) achieve rents, and 3) keep ahead of competitors. Given the uncertainty, this is risky behavior under stiff competitive conditions. It may produce excellent results, and economic rents, or it might result in failure and lead to possible bankruptcy, a variance expanding condition predicted by the Lippman/Rumelt effect.[8]

At early stages of Gamma-coevolution, rents are possible, but in the declining phase (approaching the Beta state) rents disappear.[9] The adaptation and competitive relevance of a firm's chain competencies is primarily a function of the competencies of competitors; as one competitor's competence changes, so does that of the others, until a "best practice" or convergent dominant design emerges where only minimal improvements are possible (Tushman and Romanelli, 1985, 1994; Tushman and Anderson, 1986; Anderson and Tushman, 1990). This seems to be the phase state where within-state metabolic rates may vary the most, as a competence coevolves from just after falling from the Delta state to just before falling into the Beta state.

6. DELTA PHASE STATE

Idiosyncratic Novelty. The Delta state is defined by *FC*s that are intendedly comparable among a population of competitors because they are *aimed at attaining and protecting idiosyncrasy*, not because the firms might have similar product development targets, as is characteristic of the other states. *FC*s are aimed at setting in motion 1) DC envelopes containing

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[8] The Lippman/Rumelt (1982) effect holds that firms attempting risky strategies will not on average generate economic rents—some will generate above normal returns but others will generate losses. Compared to firms taking low risk "survival" strategies, the average return for both populations will be the same, but the variance in returns for the high risk population will be greater.

[9] The famous Red Queen hypothesis (you have to run hard just to stay in place; Van Valen, 1973) would eventually come to bear some time after the Gamma state starts and could last into the Beta state.

DC systems attempting to create novel idiosyncratic chain competencies, and 2) DC envelopes containing DC systems attempting to create opacity or entry barriers. The envelopes may achieve similarity across firms for two reasons—they might use literatures/practices 1) on organizational learning, innovation, creativity, R&D management, and the like, for purposes of *creating idiosyncrasy* within the DC systems, and 2) on entry barriers, transaction cost economics approaches to minimizing the appropriation of quasi rents, and information impacting, for purposes of *increasing opacity or blocking entry*. Although there is similarity across firms at the DC envelope level, because of intended comparability (competing firms presumably all would like the advantages of idiosyncrasy), the specifics of the "*E*s and *R*s" of the competing firms' DC systems are intendedly as idiosyncratic as can be attained.[10]

This state consists of firms' exploratory or innovative trials-successes-errors that are intendedly independent of other firms and are intendedly, though not necessarily successfully, beyond the known best practice of the Beta state. Changes in chain competencies are *isolated* from what other firms are doing in that there is not (or not yet) a coevolutionary drive toward marginal performance. The chain competencies in question *could* be the same, worse than, or better than competencies of firms in the Beta or Gamma states. The determining factor is not "better or worse" but rather isolation. Because there is the risk that a Delta-jump may fail, the Lippman/Rumelt effect applies. Maintaining a state of idiosyncrasy in the face of coevolutionary tendencies and technological uncertainty would appear to require a very high metabolic rate.

The main RBV thrust falls within the Delta state. Isolated firm attempts to adapt may or may not result in what RBV defines as a competence (Mosakowski and McKelvey, 1995). If a

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[10] A useful analogy here might be cryptographic codes. Much of modern computer-based cryptography is well known and standardized in textbooks, yet the resulting codes are intendedly and totally idiosyncratic and mostly indecipherable—cryptographic technology coevolves and has many comparable elements, but the codes themselves are idiosyncratic.

firm moves into a situation where it is an early mover on a particular chain competence (i.e., without significant competition) rent generation is possible. If a firm leaves a competitive niche for a new one, what ecologists call niche separation (McKelvey, 1994), its early adaptations might be idiosyncratic (but not necessarily, as it might mistakenly try old methods in the new setting, or try methods new to it but already known to competitors). The distinction between Beta and Delta states suggests that firms have to choose between competing for ecological survival (at marginal profits) vs. higher energy/higher risk attempts to achieve rents. Clearly, the dependent variable of population ecologists, Beta-survival, is incompatible with the strategists' dependent variable, sustainable competitive advantage, that is, Delta-idiosyncrasy.[11]

My emphasis on isolation does not imply an absence of competition, only that there is not competition on one or more specific chain competencies. Firms could respond to intense competition via trial-and-error learning and could develop chain competencies without ever knowing about or attempting to copy another firm's competencies. Firms could conceivably compete on price, ROI, ROE, etc., without actually competing directly, in the sense of intendedly comparable *FC*s, on any of their respective chain competencies. Idiosyncrasy in a particular competence may be opaque to other firms because: (1) It is difficult to understand and copy; (2) The firm makes it that way; (3) Other firms are not interested in the competence in question.

7. Zeta Phase State

Multicoevolutionary Leap-frogging *Across* Product Life-cycles. This state has been depicted in recent articles by Bourgeois and Eisenhardt (1988), Eisenhardt and Bourgeois (1988), Eisenhardt (1989), Stalk and Hout, 1990; Sanchez (1993), Brown (1994), D'Aveni (1994), Eisenhardt (1995), and Eisenhardt and Tabrizi (1995) all of which focus on rapid paced, high-velocity product development settings. Perhaps the classic example of firms in this state are those in the fixed disk industry, where there have been geometric changes in size reduction, capacity increase, speed increase, reliability increase, product life cycle shortening, and cost reduction in hard drives (Christensen, 1992). This kind of competition would seem to call for a metabolic rate at the top of the scale. Many microcomputer hardware and software, airline, financial services, high fashion, and kindred firms could have value chain adaptation cycles falling in this state. Product life cycles and chain adaptations lasting from nine months to three years seem typical.

My metaphor here is an explosive plasma of a hot ionic gas, where the focus is on the initial conditions creating the explosive stream, with little control over events once the explosion is unleashed. Similar to the ionic gas metaphor, a central inductive finding coming from the prior cited work is that much of the management definition of the product development strategies of effective high-velocity firms seems to occur before the product development "event streams" are unleashed. Executives deal with this extremely fast paced world by structuring it in advance. The traditional reactive organic conception of the contingency theorists (Burns and Stalker, 1961; Lawrence and Lorsch, 1967) is too slow for the high-velocity state (Eisenhardt and Tabrizi, 1995). Instead, forces are defined in advance and then the product development event stream progresses rapidly toward success or failure, with little if any intermediate adaptive intervention by higher management. However, Eisenhardt and Tabrizi (1995) find that even though mostly designed in advance, a contingent aspect still seems present—under certainty a time-compression design is used; but under uncertainty an accelerated, iterative, rapid learning approach is more effective.

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[11] This point is elaborated in Mosakowski and McKelvey (1995).

Management does not have time, however, to change strategies in product development midstream.

This state is generally similar to the Gamma state except that the leap-frogging is across product life-cycles rather than within life-cycles. This state is defined by *FC*s that are intendedly comparable because the product life cycles are so short—there is "only one shot at the window." These intendedly comparable *FC*s attain similarity because: (1) Effectively competing firms would all tend to use DC envelope parameters governing the design of high-velocity event streams; (2) Managerial rationality and governance structures must of necessity be defined in advance—since there is not time to organically react to the event streams as they unfold; (3) Firms in the Zeta state, similarly to firms in the Delta state, will tend to draw on underlying literatures and previously known, possibly standardized, possibly mimetic design solutions expected to produce fast paced event streams leading to success rather than failure. The specifics of the *E*s and *R*s in each competing firm's DC systems would presumably unfold in very idiosyncratic fashion. The Lippman/Rumelt effect also applies in this state, because risk on a life-cycle jump is very high.

IV. HORIZONTAL DELIMITATION OF IDIOSYNCRASY

Mosakowski and McKelvey (1995) reduce the effects of idiosyncrasy by *translating* idiosyncrasy in to statistical regularities, that is, D-S logic, by using intermediate objectives as proxies of underlying competencies. McKelvey (1995b) reduces idiosyncrasy via *vertical absorption*, thereby also ending up with D-S distributions. A third possibility is that idiosyncrasy, as an inhibitor of scientific realism, may be further diminished by drawing *horizontal delimitations* among of organizational phenomena having different metabolic rates.

A. DELIMITATION BY PHASE STATE PHENOMENA

The dominant analogy in vertical idiosyncrasy absorption is Boyle's Law, in which idiosyncratic gas particle movements are changed into pressure streams having predictable regularities, or at least predictable statistical fluctuations, that is, D-N or S-F logics apply. For horizontal delimitation a useful analogy is physicists' distinction between Einstein's theory of relativity and Newton's theory of motion. When phenomena move at slow, low energy speeds, the deterministic laws of Newton apply—D-N logic. But as speeds (energy states) increase, the probabilistic assumptions underlying relativity theory have to be applied—D-S logic. Physicists and engineers, go back and forth between the two logics (Brody, 1993; Cohen and Stewart, 1994). At particle levels of analysis, physicists and biologists now use both D-N and D-S logics, depending on the situation (Nei, 1987; Cohen and Stewart, 1994).

By focusing on phase states of adaptive progression at the value chain competence "parts" level of analysis, I point organizational analysis in two new directions:

1. By introducing the ***metabolic rate*** at which adaptive progression takes place, I argue that organizational phenomena adapt at different energy states and, following physicists and biologists, we therefore may apply D-N, D-S, or S-R logics, depending on the energy state of a given chain competence's adaptive progression.
2. By introducing chain competencies as ***parts***, I recognize that the analysis of phenomena within firms may find parts adapting at different paces, and therefore proper analysis of organizational phenomena cannot proceed as if they all fit the same assumption as to metabolic rate and predictability level.

By way of analogy, imagine a primeval pond filled with water, ice, wood, fish and other organisms, gas bubbles seeping up from the bottom, with an occasional gas explosion set off by lightning—phenomena existing in different energic phase states (though nothing is approaching absolute zero). Eighteenth century physicists and biologists would have used only D-N logic to study all of the phenomena in the pond. Modern scientists draw on several logics, depending on which phenomena they are analyzing. Modern sciences are considered monoparadigmatic, yet they consistently use different explanatory/predictive logics. By failing to differentiate among organizational phenomena existing in different phase states, organizational scientists are analogous to 18th century physical and life scientists. With the two points mentioned above, my purpose is to pull organizational scientists into the 20th century. I argue that organizational science, like physics, chemistry and biology, is *not* multiparadigmatic—it is better be seen as monoparadigmatic with different predictability logics included, just like the other more mature sciences.

Of course, all this is easy to say. The crux of the matter is the degree to which idiosyncrasy can be delimited in terms of the adaptive progression phase states. This analysis also draws heavily on intended comparability, Sommerhoff's directive correlation analysis, and distinctions between DC envelopes and DC systems—all discussed in more depth in elsewhere.[12]

B. PREDICTABILITY LEVELS OF PHASE STATES

Beta Progression. Since market needs and best practices are *known*, there is an opportunity here for scientists to use the D-N/S-F models (D-N for theory; S-F for empirical research), that is, given known conditions *C*, and applicable laws *L*, one can predict *C* always leads to *E*. Industry value chain conditions calling for various best practices are known and operationally identifiable, as in the quick print industry. Rules explaining why a specific practice leads to a particular outcome are also well understood to apply. Given a condition such as a certain kind of customer need, many people would know what kind of chain competence will satisfy the need.

There are some embedded auxiliary hypotheses suggesting that an individual competence may be a necessary-but-not-sufficient cause of survival but necessary-and-sufficient cause of failure. For example, having best practice in memory capability may not guarantee a laptop maker survival, given that other best practices are also necessary, but not having up-to-date memory capability may easily cause failure. Population entry, stability, and change could also affect predictions bearing on survival, though probably not on failure. For a population of firms where all critical competencies are in the Beta state, and controlling for population regulation effects, one should be able to make predictive statements concerning survival.

Gamma, Delta, and Zeta Progression: DC Envelope SR-distributions. In these phase states, intendedly comparable *FC*s create DC envelopes containing *design parameters* governing design solutions at the DC system level (as developed in Part I by McKelvey 1995b). Parameters are analogous to rules governing the design of pressure vessels—vessels may differ in design but the rules governing the relations between strength of materials, size, weight, pressure capability, safety limits, and so forth, are constant factors underlying the idiosyncratic design decisions. As argued in Part I, the D-S model therefore applies to the DC envelope design parameters. Here one expects that there will be conditions *C* and laws *L* such that *C* will lead to SR-distributions *D*. One can also expect that there are various *adaptive progression rates* in SR-distribution form. Generally, there could be SR-distributions of:

1. Conditions governing the creation of intended comparability.
2. Conditions governing DC envelopes as independent or dependent variables.
3. Conditions governing the nature of the resultant DC envelopes.
4. Parameters associated with each and every competence within a value chain.
5. Parameters governing which parts of a chain will become subject to Gamma or Delta state rules, and so on.
6. Rates at which chain competencies move into or out of a particular state, or rates at which states diffuse to other competencies, or decay to lower metabolic levels.

Though the general principle is the same for all three states, some specifics differ:

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[12] See Mosakowski and McKelvey (1995) and McKelvey and Mosakowski (1995).

1. *Gamma State*. *D*s include *design* parameters governing DC system solutions for coevolutionary adaptation, as well as parameters governing *rates* at which coevolutionary progression, 1) diffuses across a population, 2) decays into the Beta state, and 3) starts, given a Gamma state.
2. *Delta State*. *D*s include *design* parameters governing DC system solutions for making them opaque and for creating entry barriers as well as parameters governing *rates* at which, 1) opaquenesses and barriers might decay, 2) idiosyncrasy decays into the Gamma state, and possibly 3) rates at which idiosyncratic DC systems might progress toward augmented idiosyncrasy.
3. *Zeta State*. *D*s include *design* parameters governing DC system solutions for setting up DC system initiating structures creating high-velocity product design approaches as well as parameters governing *rates* at which high-velocity progression, 1) diffuses across a population, 2) decays into the Delta or Gamma states, and possibly 3) might progress toward enhanced Zeta states.

The DC envelope concept fits scientific realism. Given the intended comparability of the *FC*s, there is reason for researchers to expect similarity across firms at the DC envelope level of analysis, thereby allowing for prediction, generalization, and falsification of SR-distributions.

Gamma, Delta, and Zeta Progression: DC System SR-distributions. Drawing again on the gas laws, the pressure vessel has the effect of translating idiosyncratic gas particle movements into output pressure streams having SR-distributions (elaborated in Part I). Analogously, *effectively* designed DC systems translate idiosyncratic organizational behaviors at the parts levels to outcome behavior “pressure” streams having SR-distributions, due to the intended comparability of the *FC*s. By this logic, effectively designed DC systems generate a statistical distribution of outcome behaviors likely to have a predictable mean and variance—there is not a single best way of effectively attaining a particular *FC* (given cost, time, creativity, etc, constraints), but neither are there an infinite number of *effective* mixes of random attributes. The key word here is “effective.” My hypothesis is that effective outcome streams show an SR-distribution of behavioral elements, whereas ineffective streams remain stochastic as to content.

At this juncture scientific realism does not appear amenable to most of the idiosyncratic DC system phenomena *inside* the DC envelope. This statement applies to the DC system aspects of Gamma, Delta, and Zeta phase states. Even though the DC envelopes of these states are intendedly comparable, and even though one may predict many envelope similarities across competing firms, one has little basis for expecting that the chain competencies comprising the DC systems firms might develop to achieve these *FC*s might in any way be predictably similar. The *E* and *R* contents of DC systems are not deterministically predictable event by event; thus there is little likelihood of prediction, generalizability, or falsification in terms of D-N, S-F, or D-S logic. It might be possible that I-S logic with a weak form of falsifiability could fit this state, but 90% event arrival probabilities seem highly unlikely. S-R levels of predictability seem most likely in that patterns showing slightly better than random chances of occurring may be discovered.

Gamma, Delta, and Zeta Progression: Idiosyncratic Components. While DC envelopes and systems each have an SR-distribution component, they both also have idiosyncrasy. In DC envelopes, design solutions are idiosyncratic, though the parameters follow D-S logic. In DC systems, the *E*s and *R*s are idiosyncratic, though the outcome stream follows D-S logic. For the idiosyncratic components, one is left with *post hoc* explanations, such as, evolutionary or natural history narratives, case studies, or other qualitative inductive methods. Discovery "logic"[13] seems applicable to these circumstances, but very rarely justification logic. There are minimal grounds for predicting that a finding will repeat, will generalize to a different firm or population, that it will apply to a later circumstance, or that a finding has any truth beyond the "belief" of the investigative narrator that "to the best of his or her ability the events transpired as recorded."

Alpha Progression. There are several possibilities: (1) Perhaps no model of aggregate explanation applies. Where value chain competencies are locked in a state of no progression, and not responding to some external criterion variable, such as competitive survival or rent generation, there may be no *pattern* of competence behaviors to be identified or explained.[14] Chain alterations may be random, and one kind of alteration no more adaptive than any other. (2) The Alpha state, by definition, indicates that chain competencies are *not* in a state of adaptive progression. Taking this view, one could study, using the S-R or possibly I-S models, firms' abilities to successfully hold to past successful behaviors, routines, tacit knowledge—processes that might explain the widespread "Icarus paradox" (Miller, 1990). If survival in terms of a changing environment is deemed irrelevant, then vestiges of past success may be the only alternative driving forces, and therefore, the only source of "pattern" in chain competencies. (3) Success in adhering to a founder's or some other group's imprint, or emergent cultural norms, could result in an Alpha state, as illustrated by the neurotic founder imprints described by Kets de Vries and Miller (1984) (also Genrad). In the locked state, behaviors might appear driven by the founder's personality or wishes, since by definition they are not adaptive to external forces. Since these kinds of patterns would be idiosyncratic to a given firm, only the S-R model might apply.

V. THE PHASE STATE RESEARCH AGENDA

In this section I outline a few questions suggesting directions for phase state research, focusing on DC envelope design parameters, rates, and outcome pressure streams, all of which fit D-S logic. The main themes of the research agendas pertain to coevolutionary competence "parts."

A. PHASE STATE IDENTIFICATION

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[13] Logical positivists and scientific realists agree that there is really no uniform discovery "logic" that one can point to (Popper, 1959: 31; Hunt, 1991: 294)—the scientific record shows discovery to be quite unpatterned.

[14] Observers might say that the survival criterion always applies, and we would agree. It is also true, however, than many firms do not behave as if this were true—they seem to exist in a truly locked (frozen) Alpha state, except for random events, the GENRAD case being a classic example.

As presented here, firms as inclusive wholes contain value chain competence parts in various phase states—it is competencies that are in one or another phase state, not whole firms. A given organization could have portfolios of chain elements in all five states, like the primeval pond mentioned earlier—phenomena at different energy states. As the pond changes in its nature, hospitality toward animals, and ability to survive as a pond (depending on whether it is filled with ice, debris, algae, or water), so also an organization changes its nature, hospitality toward employees and customers, and ability to survive, depending on the phase states of its chain competencies. A number of identification tasks seem appropriate (these could be from management's or a researcher's perspective):

1) Hierarchical classification (McKelvey, 1982) of the more evolutionarally significant chain competencies across firms within a population seems necessary since, in the "parts" view of coevolution, competition causes adaptive progression at the parts levels.
2) A hierarchical analysis of chain competencies that seem critically important to survival, growth, attaining rents, etc. For any given firm, some elements are probably unnecessary and others are needed, but given costs and the nature of the competition they may not be critically important.
3) The phase states of the various chain competencies.
4) The desired portfolio of chain phase states for strategic purposes.
5) Phase state transitions to be expedited, encouraged, or resisted.
6) Kinds of change/transformation approaches best fitting the various phase state transitions. These might also differ, depending on the nature of the targeted chain competence.

B. GAMMA PHASE STATE

The Gamma phase state seems potentially the most interesting and most important because strategists inevitably are drawn into the study of direct competitive interaction among firms. Further, at the level of value chain competencies, *coevolutionary* competencies, as parts, seem to be phenomena heretofore largely unrecognized as worth investigating.[15]

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[15] We note that some of the "diffusion of innovation" literature could pertain to chain competencies under coevolutionary conditions, but on the other hand the focus of the diffusion researchers is not primarily on value chains, competitive pressures, or

The following questions suggest a possible research agenda for the Gamma state:

1. **Degree of Intended Comparability.** Why do firms make some chain *FC*s intendedly comparable and not others? If envelopes appear as decomposed hierarchies of *FC*s, what determines how far down the hierarchy the *FC*s become intendedly comparable and coevolutionary?
2. **DC Envelope as Dependent Variable.** What conditions affect its capacity to achieve the *FC*, the speed at which it fosters effective design solutions, or its ability to withstand or stay ahead of coevolutionary pressure? Is the number of coevolutionary DC envelopes in a firm related to overall performance? What causes envelope characteristics?
3. **DC Envelopes as Independent Variables.** How do DC envelopes create idiosyncratic and opaque DC systems? In what ways do envelopes cause different SR-distributions in DC system outcome streams? What are the important trade-offs for envelope design parameters?
4. **Coevolutionary Effects.** How do firms make DC envelopes and systems more or less subject to decay (into coevolution)? Is the number of competencies under coevolutionary pressure, relative to overall performance, nonmonotonic? Does coevolution take place only when firms seek rents?
5. **Adaptive Progression Rates.** Do rates at which coevolutionary cycles get started differ by industry? By chain competence? What are the adaptive progression decay rates of coevolutionary cycles (that is, the rate at which the competence is competed to marginality)? Are progression rate decays geometric? Is this due to firm conditions or environmental conditions? Are their advantages to firms of speeding up or slowing down the progression rates?
6. **Metabolic Rates.** What is required to raise behavioral functioning to Gamma level metabolic rates? What might keep them from decaying to Beta levels? Does a Gamma level metabolism require different internal "culture," "climate," "interpersonal chemistry," or management approaches?
7. **Adaptive Advantage.** Drawing from the relationship Porter suggests, between a nation's competitive strength and pockets of coevolution, does the same relationship hold for firms? That is, do portfolios of coevolutionary chain competencies (say in one or two sections of the chain) offer a firm more overall competitive advantage than intendedly comparable *FC*s spread out more randomly throughout the chain?
8. **Niche Effects.** Is coevolution a niche effect or a firm effect? Is coevolution more likely at the *r* stage or the *K* stage, or for *generalists* or *specialists*? Is the rate of decay related to niche separation? What are the conditions affecting the length of time after niche separation before coevolution begins?
9. **DC Systems.** What is the nature of the DC system outcome pressure streams, as solutions for attaining the *FC*, that is, are they SR-distributions across firms, and if so, what shape? Also across firms, is there an SR-distribution of key behavioral components of the outcome streams, even though the DC systems producing the streams are idiosyncratic?

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even adaptive progression. The dominant design and technology cycle approach of Anderson and Tushman (1990) necessarily includes coevolutionary value chain progressions, but these are not the central focus of their work.

C. DELTA PHASE STATE

The Delta phase state gains its interest because it is the subject of RBV. The main point to realize here is that even though the strategic advantage of the state is idiosyncrasy, D-S logic and scientific realism still have relevance—not all research has to be natural history cases.

1. **Degree of Intended Comparability.** How many *FC*s should a firm attempt push into the Delta state, *i.e.*, how many focusing on idiosyncrasy, opaqueness, and barriers? Are nested FCs a particular advantage in the Delta state? What is the relative importance between primary and support chain competencies as sources of idiosyncrasy, opaqueness, and barriers? Is it possible for certain kinds of idiosyncrasy and opacity to prevent intended comparability? Of all the chain competencies, which ones become the focus of competitive attempts to maintain idiosyncrasy and opacity?
2. **Envelopes as Dependent Variables.** What conditions affect a firm's ability to set up DC envelopes in the Delta state? Or its ability to produce envelopes that foster idiosyncrasy in the face of coevolutionary pressures? What conditions foster envelope designs that maintain opacity or create barriers? Is getting a competence into the Delta state a function of the firm or the particular competence?
3. **Envelopes as Independent Variables.** Why do some envelopes generate more idiosyncratic, nonmimetic solutions than others? Do different kinds of envelopes cause different kinds of pressures toward adaptive progression, pressures toward higher risk-taking, more variation-selection-retention, or more opaqueness? What conditions affect the ability of envelopes to produce and maintain idiosyncratic and opaque DC systems? What are the important design parameters?
4. **Idiosyncrasy Envelopes.** Are there preferred ways of achieving idiosyncrasy, that is, while the results may be idiosyncratic, are there predictable DC envelope processes fostering idiosyncrasy? What is the relation between individual chain idiosyncrasies and rent generation? Are rents more likely to come from a very few idiosyncratic chain competencies that can be kept opaque, or from a broad set of idiosyncratic competencies? Are there unfortunate side-effects to idiosyncratic competencies? Are some elements of the chain critical to be idiosyncratic on while others contribute more if they are not idiosyncratic?
5. **Opaqueness Envelopes.** What are the DC envelope designs that affect a firm's ability to keep DC system advances opaque to competitors? Do firms benefit by forestalling coevolutionary behavior? Are there conditions when they do or they don't? How to prevent coevolution?
6. **Progression Rates.** What is the rate at which decay into the Gamma state progresses? Are these rates mostly functions of technology, firm, or envelope attributes, or other factors?
7. **Metabolic Rates.** Does idiosyncrasy require a metabolic rate in between the Zeta and Gamma states, as hypothesized here? What behavioral requirements are there for instigation and maintaining organizational functioning in the Zeta state?
8. **DC System Research.** Are we limited to retrospective logic, case studies, and natural history lessons, as Porter and others seem resigned to? Are S-R and I-S logics applicable or useful? What can be done to

improve the quality of discovery logic and the credibility of observers and narrators. How much space should scientific journals devote to nongeneralizable, idiosyncratic natural history phenomena? What ratio between discovery and justification logics is appropriate?

D. ZETA PHASE STATE

Since the Zeta phase state is relatively recently identified, it also takes on importance simply due to its novelty.

1. **Degree of Intended Comparability.** How many value chain *FC*s in a firm should be pushed up to the Zeta state? To what extent are they primary or support value chain phenomena? Is there an optimum number of chain competencies to be pushed up to this energy level? Does the intended comparability of envelopes produce the same envelope attributes across industries or only across firms in the same industry?
2. **DC Envelope as Dependent Variable.** What conditions affect Zeta DC envelope attributes? Which attributes lead envelopes to outperform others in attaining *FC*s? Are envelope attributes a function of the chains most important for progression in the Zeta state or a function of other firm or niche characteristics?
3. **DC Envelopes as Independent Variables.** Why do some envelopes produce DC systems more effective in producing chain competencies better suited to the needs of Zeta state firms? Are envelope attributes more a function of the underlying literatures, for example of rational managerial action, than on the technologies and other environmental conditions creating the adaptive need for the envelopes?
4. **Initiating Function.** Is the Bourgeois and Eisenhardt (1988) discovery of high-velocity initiating structures generalizable? Is high-velocity adaptive progression solely a function of the DC envelopes or can it also be a function of DC system developments, or mid-product life cycle adaptations (Gersick, 1994), or contingent on uncertainty (Eisenhardt and Tabrizi, 1995)?
5. **Progression Rates.** How long before chain competencies developed in the Zeta state "fall" into the Delta or Gamma states? At what rate are Zeta competencies produced? Are there rates at which Zeta DC envelopes become obsolete? Are these technology driven? For high-velocity technologies, are their optimum rates at which DC envelopes should be created? How many can be effectively managed in parallel? Are there rates at which DC system phenomena become idiosyncratic due to intrafirm effects? Are their rates at which DC system phenomena become similar, due to the effects of comparable envelopes, literatures underlying the initiating structures, broader technological effects, etc.?
6. **Metabolic Rates.** What kinds of organizational behavior is required in the Zeta state? Can firms in the Gamma or Delta states be metabolically speeded up so they can compete in the Zeta state, or does this kind of behavior only occur in start-up situations.
7. **Adaptive Progression.** Which chain competencies have to be pushed up to the Zeta state for effective adaptive progression? Which can safely be ignored? Can this be done incrementally or is it more of a quantum change phenomenon, as suggested by Miller and Friesen (1984)?

8. **DC Systems.** Do DC systems within Zeta state DC envelopes have different attributes from those in the Gamma state? There could be significant patterns of DC system chain processes that are similar across firms at an S-R or possibly an I-S level of predictability that emerge as firms respond to Zeta state *FC*s.

E. BETA PHASE STATE

It would seem that most firms compete with portfolios of value chain competencies, a Gamma set, a Delta set, and a Beta set. Here we consider the latter. The logic of best practice "benchmarking" has been pursued mostly at the production level of the value chain. It seems logical that the benchmarking approach (theory and method) could be extended to other primary and support chain competencies where best practice appears to have been established.

1. **Best Practice.** In a given industry, to what extent is best practice established across different chain competencies? Are some parts of the chain always known to meet best practice standards? Do some parts never seem to develop to the point of meeting known best practice? Do best practices consistently elude some parts of the chain? Are best practices on a sizable portion of the value chain required as a platform for the Delta or Gamma competencies that lead to rents? Do best practices only emerge after *K* conditions are reached, as the population ecologists would predict?
2. **Establishment.** When does a chain element achieve the status of best practice? To what extent is this status clearly known or without argument? In some industries, do best practices ever exist?[16] Can managers focus on best practice and rent generation at the same time? Can firms transition between the Beta state and other states with ease or only with great difficulty?
3. **Survival.** Does a total focus on best practice in fact lead to survival? Can firms survive with no effort given to rent generation attempts, which is to say, entrepreneurship? Does emphasis of best practice have a negative effect that may slow down or stop Delta or Gamma state rent generating attempts? What is the ratio between Beta and the other states that leads managers to be indifferent between survival vs. rent generation orientation? Can firms survive without any best practices, choosing instead to pursue adaptive progression via idiosyncrasy or coevolution?

F. PHASE STATE TRANSITIONS

One might reasonably inquire as to the nature of phase state transitions. There are several key questions: (1) Are the transitions abrupt or imperceptible? (2) Do causes of transitions differ across the several chain portfolios a firm might have? (3) Do implementation behaviors differ across transitions? I present phase states as hierarchically arranged energy levels. Following the analogy with physical matter, do higher phase states not only take the extra energy to function at the higher state, but do they also take an *energy peak* just to overcome the transition barrier?

Received theory suggests that the transition from one phase state to any other state is more likely abrupt than imperceptible. A variety of causes falling under the label of "inertia theory" support this. Resistance to change has been known to be ubiquitous for decades (Lewin, 1947; Lawrence, 1954; Argyris, 1970; Zaltman and Duncan, 1977), requiring considerable force to overcome. System interdependencies are known to cause organizations to fail to change incrementally (Miller and Friesen, 1984). Environmental forces also cause organizations to stay inert (Hannan and Freeman, 1984). Only when technological change is competence destroying do organizations tend to make wholescale and typically abrupt changes (Romanelli and Tushman, 1994). And, once multicoevolutionary complexity is recognized (McKelvey, 1995b), phase state transitions become more complicated. As implied in the previous distinctions between progression and metabolic rates, one issue for a firm is, Can it adopt the intentional competitive strategy of a different phase state? A second issue is, Can it alter its metabolic rate in keeping with the requirements of the different phase state chosen. A number of research issues appear interesting:

1. **From the Alpha Phase State?** Does inertia theory apply mostly to jumps from the Alpha state to other states? Can a firm be primarily in an Alpha state but coevolve on a few chain elements, or is it "all or nothing," as the quantum (Miller and Friesen, 1984) and punctuated equilibrium (Tushman and Romanelli, 1985; Tushman and Anderson, 1986) views suggest? How many chain elements have to be undergoing change before it is agreed that the firm is indeed in a state of adaptive progression?

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[16] A recent study by Anderson and Tushman (1990) suggests that a dominant design aspect of best practice may not always appear.

2. **Alpha to What?** If a firm is genuinely in an Alpha state, what does it take to jump to another state, even on one chain element? Is it possible for a firm to go from Alpha to Delta? Probably not. From Alpha to Beta? Probably, though even here inertia and change theory suggest that this could be difficult.[17] What about to the Gamma state? Probably, a firm can jump into the Gamma state from any other state, and be dragged into the Gamma state by another competing firm.
3. **From the Delta State?** Can a firm ever be idiosyncratic on all chain elements? What are the processes by which opaqueness breaks down? Can a firm have a strategy as to which chain elements are kept opaque, if that is possible? Can a firm be effective at maintaining Delta and Gamma competencies at the same time? What personnel selection, management, or structural approaches foster this? Once coevolution starts on one element, can a firm successfully prevent the erosion of opaqueness?
4. **Most likely course?** Is there an inevitable trend from Zeta → Delta → Gamma → Beta → Alpha? Is there any likelihood of jumps from the Alpha to the Delta state? Do these "transformations" occur only after heroic surgical changes by new managements? Are their limits to phase state adaptation, as the population ecologists would suggest? Is the Zeta state different from the others in terms of its transition phenomena.
5. **Phase state Transitions.** What is the nature of phase state transitions? Are they abrupt or imperceptible? When do they start or stop? Can existing firms make any phase transition they wish, or does inertia prevent this? Can they make transitions to nonadjacent phases? If this is possible, can an organization handle different kinds of nonadjacent jumps at the same time (that is, between Alpha ←→ Delta or Gamma, or between Beta or Gamma ←→ Zeta)? Is there a learning curve in handling transitions? Is competitive advantage in transition capabilities or in the states? Both? Is across the board chain competence transition ability a dynamic capability likely to generate strategic advantage?

Given multicoevolutionarity and metabolic costs, the Zeta ⇒ Delta ⇒ Gamma ⇒ Beta ⇒ Alpha transition would seem to follow the path of least resistance, beginning with a lengthening of product life-cycles, a breakdown in opaqueness on one chain element, through coevolution on one and then on several to many competencies, then reduction to marginalization at a best practice level on most key elements, and eventually into an Alpha state, if a long stable period exists, as would be suggested by the work of Tushman, Romanelli, and Anderson. Most of the traditional organization development (OD) change methods seem oriented toward nudging firms from the Alpha state toward the Beta state (French, Bell, and Zawacki, 1994). Now that there is a distinction between "transformation" and more traditional views of OD (Porras and Silvers, 1991), the transformation literature arguably could be seen as focusing on jumps from the Alpha or Beta states to higher levels of adaptive progression, that is, Gamma, Delta, or Zeta states (Beatty and Ulrich, 1991; Tichy and Sherman, 1993; Baden-Fuller and Stopford, 1994; Heckscher, Eisenstat, and Rice, 1994; Banner and Gagné, 1995) As indicated in the O D literature (for example, French, Bell, and Zawacki, 1994), and recently by Mottur and Associates (1995), metabolic rate changes from the Alpha state to the Beta state seem immensely difficult. Yet people using the "transformation" approach appear to imply that firms can transform themselves willy-nilly from one state to another. One might reasonably conclude that it is well nigh impossible for Alpha metabolisms to be changed into anything but, perhaps, Beta metabolisms.

VI. CONCLUDING PART II

Summary. In Part II, I draw on several key ideas developed in Part I (McKelvey, 1995b), specifically, scientific realism, idiosyncratic value chain competencies, levels of predictability, Sommerhoff's (1950) concept of directive correlation, and two derivative concepts, DC envelopes and DC systems. Recognizing that firms may compete directly on specific competencies, I then focus on coevolutionary processes, using *multicoevolutionarity* to recognize the probability that firms may coevolve on a number of competencies simultaneously. Next I suggest that firms may transform energy at different *metabolic rates*. Because of strategic intent, the various chain competencies comprising a firm may operate and be adapted at different metabolic rates. Given that adaptive progression of chain competencies proceeds at different rates, organizational phenomena appear in a hierarchical ranking of phase states: *Alpha* (locked), *Beta* (best practice),

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[17] Presentations by five internal change agents from a sample of "dinosaur-like" firms (railroad, telephone utility, cement, bank,

Gamma (coevolutionary), *Delta* (idiosyncrasy), and *Zeta* (high-velocity). Once organizational phenomena are categorized into phase states and DC envelopes and DC systems, they admit different levels of predictability, though much of organizational phenomena appears to call for the use of Hempel's (1965) *deductive-statistical* model of explanation. This altered view of organizational phenomena suggests many new questions to be investigated.

Value chain/Phase State Matrix. To the extent that the more scientific realist side of organization science lately has been dominated by population ecologists and industrial organization economists staying at the industry level of analysis, firms have been treated as largely undifferentiated black boxes in populations moving inexorably toward equilibrium. This is not unlike physicists and chemists trying to study the material universe without differentiating it into an array of *elements* (rows) appearing in near absolute zero, solid, liquid, gaseous, or plasma *states* (columns). Following physicists and chemists rather than population ecologists and I. O. economists, this paper differentiates the phenomena of interest to organization science into an array with **value chain competencies** as rows and **phase states** (Alpha, Beta, Gamma, Delta, Zeta) of adaptive progression as columns. Given how physics and chemistry became successful, I suggest that organization science might not achieve successful scientific status until its scholars understand organizational phenomena as differentiated phase states with differing levels of predictability.

Multicoevolutionarity. The noted biologist, Kauffman (1993: 237; his emphasis), says:

> The true and stunning success of biology reflects the fact that organisms do not merely evolve, they *coevolve* both with other organisms and with a changing abiotic environment."

U. S. post office) at the recent Organization Science Winter Conference at Snowmass, showed how difficult it is just to get from the Alpha to the Beta state, which none of them has achieved as of yet (Mottur and Associates, 1995).

Following Kauffman, I have drawn on a careful definition of coevolution and have shifted the coevolutionary perspective to the "parts" level of firms, that is, *multicoevolutionarity*. Further, the Gamma phase state, consisting of the coevolutionary adaptive progression of value chain competencies seems particularly salient. Intervening between the Delta and Beta phase states, the Gamma state seems critical for understanding how firms transition from idiosyncrasy (the focus of many academic strategists), to best practice benchmarking (the focus of many practitioners). Some key questions pertain to adaptive progression rates: Given idiosyncrasy, how long before coevolutionary pressure begins? How long before coevolution reduces to best practice? And, how can the beginning or ending of coevolution be slowed down or speeded up?

VII. REDEFINING ORGANIZATION SCIENCE

We began these papers by noting that a fundamental dilemma exists for organization science: *Scientific realism appears incompatible with the idiosyncratic phenomena encountered in firms*. In Parts I (McKelvey, 1995b) and II we make the following arguments:

1. *S. multi*. is a symptomatic outcome of an underlying illness, *O. idio*.
2. *O. idio*. results from idiosyncrasies produced by process/event sequences, value chain competencies, and multicoevolutionarity.
3. Scientific realism is the best philosophical umbrella under which to pursue a "self-correcting" organization science, based on the widely accepted "prediction/generalization/falsification" justification logic used by more mature sciences enjoying broad societal financial support and legitimacy.
4. Firms are best seen as consisting of nested multicoevolutionary value chain competencies as "parts."
5. The most viable molecular lower bound "platform" upon which to create a widely accepted organization science is one consisting of stochastically idiosyncratic process/event sequences.
6. Vertical idiosyncrasy absorption occurs at various organizational levels via the Cohen and Stewart (1994) process of "contextually emergent simplicity" that results in statistical regularities, that is, SR-distributions.
7. Directive correlation (Sommerhoff, 1950), DC envelopes, and DC systems offer a more explicit conceptual language for understanding the emergent simplicity effect.
8. Chain competencies in firms appear in various metabolic phase states of adaptive progression: Alpha (locked), Beta (best practice), Gamma (coevolutionary), Delta (idiosyncratic), and Zeta (high-velocity), that are ranked hierarchically in terms of metabolic rate. Firms may have chain competencies in each state.

9. Horizontal idiosyncrasy delimitation, via DC envelope design parameters and DC system outcome "pressure" streams, occurs in varying amounts across phase states.
10. DC envelope design parameters and DC system outcome streams appear to fit Hempel's (1965) D-S logic.
11. D-S logic allows organization scientists to conduct research as scientific realists, even while assuming that organizational phenomena at the "particle" level are "stochastic" rather than "uniform."

D-S Logic. Our papers place considerable emphasis on D-S justification logic. In the organization science literature, however, authors typically use D-N logic. For example:

> Firms with configurations of competence enhancing HR system attributes that are unique, causally ambiguous, and synergistic will have sustained competitive advantage over firms that have HR system configurations that are typical, causally determinate, and nonsynergistic (Lado and Wilson, 1994: 718).

We picked this proposition because it is recent and interests us—we could have picked a thousand others. This proposition is characteristic of D-N logic—if conditions *C* and covering laws *L* prevail, effect *E* always occurs. Yet most empirical studies conducted in organization science fall under S-R logic—if conditions *C* prevail, *E* has been found at a probability of occurrence slightly higher than chance, with minimal variance explained. Authors incongruously write theory using D-N logic and conduct empirical justificatory research using S-R logic. The latter leaves little chance of falsification, since arrivals of result events are couched in the weakest of probability terms. How can one say a theory is false for not predicting *E*, if *E* was never expected to arrive more than 1% to 5% of the time anyway (in terms of variance explained)? D-S logic focuses on predicting *distributions*, not individual event arrivals. The foregoing proposition could be rephrased as:

> Under conditions *C* [unique, causal ambiguity, synergistic], and covering laws *L* [to be specified], in a population *P* [kind and size to be specified], the ***rate*** of arrival *R*, of firms having sustained competitive advantage, is SR-distribution *D* [mean, variance, and shape as discovered].

One Paradigm. Perrow quotes contingency theory as saying: "There can be no paradigm for all organizations or all times because organizations are ever-evolving responses to social change, and thus the context of organizational behavior is a major variable" (1994: 192). Perrow uses this logic to argue that the context of organization theory calls for a multiparadigmatic approach. We have called this sort of reasoning the *S. multi*. illness, following scholars such as Camerer (1985), Montgomery, Wernerfelt, and Balakrishnan (1989), and Pfeffer (1992). Arguing about *S. multi*. will not lead to a cure since the underlying disease, *O. idio*., remains untreated. By developing sophisticated methods of absorbing and delimiting stochastic idiosyncrasy, other sciences have cured *O. idio*., have remained monoparadigmatic, and have gained the financial support and broader legitimacy so far denied organization science.

We argue for an organization science built of multiple levels of predictability, recognizing that all idiosyncrasies cannot be purged. Explanations and levels of prediction arguably differ, depending on the phase states of chain competence "parts" and whether DC envelopes or DC systems are involved. Consequently, phrasings of propositions, methods and models, expectations for justification, degrees of falsification possible, and degrees of faith placed in findings, differ depending on the phase state and absorption level. Justification logic standards compatible with D-N logic, that seem appropriate for the Beta state, in our view, are not applicable to the other states. D-S logic seems correct for the DC envelope design parameters of the Gamma, Delta, and Zeta states and DC system behavioral outcome "pressure" streams, but S-R and possibly I-S models would seem to be the best logics available for the remaining idiosyncratic phenomena. Calls to apply the same justification logic to all phase states or all levels of analysis appear wrong-headed. By the same token, calls to throw out justification logic totally, just because it does not seem to work at stochastic DC system or particle levels, appear equally wrong-headed.

Time for Change. The analysis of organization science we offer in Parts I and II is surely alien, with many strange, difficult to understand, and inaccessible ideas. Worse, virtually no one will like the results—they put all most everyone outside the scientific edifice. Our focus on scientific realism should make it clear why we place postpositivists outside science—they fail to understand the criticality of self-correction justification logic as the only practice that sets scientific activity apart from religion, creation science, folklore, and *FORTUNE* magazine. Doing this, however, does not make us positivists or normal scientists. Modelers build models on the demonstrably false molecular lower bound assumption of uniform particles. Empirical researchers present their theoretical hypotheses in terms of deterministic *deductive-nomological* logic in which prediction focuses on individual cases, yet they accept empirical justification in terms of *statistical-relevance* logic that is totally unfalsifiable. False assumptions and unfalsifiable empirical tests put the positivists and normal scientists outside legitimate science as well.

Surely no one can doubt that the idiosyncrasy/scientific realism dilemma is a problem of heroic proportions for organization scientists. It should be clear to all that multiparadigmaticism does not gain us scientific respect. In most scientific circles organization science does not count as a real science—no member of the Academy of Science, no Presidential Council of Organizational Advisors, not one organizational scholar among the 500 experts assembled by Hillary Clinton to reform the US health care system, even though by the year 2000 health care will have shifted entirely from sole practitioner to organizational delivery. Even within organization science, people of one paradigm disbelieve the theories and findings of those following other paradigms. If we don't believe ourselves, why should outsiders pay any attention to us? Multiparadigmatic thinking draws hard boundaries around schools of thought and pushes people into extremist "either-or" positions (Hunt, 1994). It has resisted all attempts at resolution. Yet the credibility of our science, as a method of separating truth from quackery, requires an *S. multi*. cure.

Our treatment is an attack on *O. idio*., the underlying disease. In doing so we call for a decidedly novel approach to organization science. Campbell (1965, 1974), one of the fathers of universal Darwinism (see Plotkin, 1994: 83), drew on Popper to suggest that science follows a selectionist epistemology—variation and selective retention. What we propose is simply one of several epistemological variants on the table—though admittedly ours is somewhat more novel, complicated, and mindstretching. Camerer (1985) proposes holding the line on positivism. Lincoln (1985) and Weick (1985) suggest postpositivism. Pfeffer (1992) proposes a committee, perhaps reminiscent of the Vienna Circle (and we all know what they did; Suppe, 1977). Mahoney (1993) proposes conversational justification. Perrow (1994) may be tilting toward religious awe. We argue for a monoparadigmatic view of organization science that includes several levels of predictability in relatively easily identifiable circumstances. It is an approach built on the shoulders of the more successful sciences. Since it is inherently evolutionist in nature, it is a kind of science that meets the precepts of scientific realism and fits the idiosyncratic, fast evolutionary pace of organizational adaptation with ease. Minimally our approach offers the possibility of turning multiparadigmatic squabbles into empirical questions, as investigators try out one or another level of predictability on the phenomena in question. At best, it could resolve the paradigm wars.

BIBLIOGRAPHY

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

Anderson, P., and M. L. Tushman (1990), "Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change," *Administrative Science Quarterly*, 35, 604-633.

Argyris, C. (1970), *Intervention Theory and Method*, Reading MA: Addison-Wesley.

Astley, W. G. (1985), "The Two Ecologies: Population and Community Perspectives on Organizational Evolution," *Administrative Science Quarterly*, 30, 224-241.

Baden-Fuller, C., and J. M. Stopford (1994), *Rejuvenating the Mature Business*, Cambridge, MA: Harvard Business School Press.

Banner, D. K., and T. Elaine Gagné (1995), *Designing Effective Organizations: Traditional and Transformational Views*, Thousand Oaks, CA: Sage.

Barnett, W. (1994), "The Liability of Collective Action: Growth and Change Among Early American Telephone Companies," in J. A. C. Baum and J. V. Singh (Eds.), *Evolutionary Dynamics of Organizations*, New York: Oxford University Press, 337-354.

Barney, J. B. (1991), "Firm Resources and Sustained Competitive Advantage," *Journal of Management*, 17, 99-120.

Baum, J. A. C., and J. V. Singh (1994a), "Organizational Niches and the Dynamics of Organizational Founding," *Organization Science*, 5, 483-501.

Baum, J. A. C., and J. V. Singh (1994b), "Organization-Environment Coevolution," in J. A. C. Baum and J. V. Singh (Eds.), *Evolutionary Dynamics of Organizations*, New York: Oxford University Press, 379-402.

Beatty, R. W., and D. O. Ulrich (1991), "Re-Energizing the Mature Organization," *Organizational Dynamics*, Summer, 16-30.

Bourgeois, L. J., and K. M. Eisenhardt (1988), "Strategic Decision Processes in High Velocity Environments: Four Cases in the Microcomputer Industry," *Management Science*, 34, 816-835.

Boxwell, R. J. (1994), *Benchmarking for Competitive Advantage*, New York: McGraw-Hill.

Brittain, J. W. (1994), "Density-Independent Selection and Community Evolution," in J. A. C. Baum and J. V. Singh (Eds.), *Evolutionary Dynamics of Organizations*, New York: Oxford University Press, 355-378.

Brittain, J. W., and J. H. Freeman (1980), "Organizational Proliferation and Density Dependent Selection," in J. Kimberly and R. H. Miles (Eds.), *The Organizational Life Cycle*, San Francisco: Jossey-Bass, 291-338.

Brody, T. (1993), *The Philosophy of Physics*, L. De la Pena and P. Hodgson (Eds.), New York: Springer-Verlag.

Brown, S. L. (1994) "A Multiple Horizon Strategy for Managing Time in High Technology Environments: The Case of Multiple Product Development Projects," unpublished doctoral dissertation, Stanford University, Stanford, CA.

Burns, T., and G. M. Stalker (1961), *The Management of Innovation*, London: Tavistock.

Camerer, C. F. (1985), "Redirecting Research in Business Policy and Strategy," *Strategic Management Journal*, 6, 1-15.

Camp, R. C. (1989), *Benchmarking: The Search for Industry Best Practices*, Milwaukee, WI: Quality Press.

Campbell, D. T. (1965), "Variation and Selective Retention in Sociocultural Evolution," in H. R. Barringer, G. B. Blanksten and R. W. Mack (Eds.), *Social Change in Developing Areas: A Reinterpretation of Evolutionary Theory*, Cambridge, MA: Schenkman, 19-49.

Campbell, D. T. (1974), "Evolutionary Epistemology," in P. A. Schilpp (Ed.), *The Philosophy of Karl Popper (Vol 14, I & II). The Library of Living Philosophers*, La Salle, Il: Open Court, 413-463.

Christenson, C. (1992), "Rigid Disk Drives—An Industry Note," case, Boston, MA: Harvard Business School.

Cohen, J., and I. Stewart (1994), *The Collapse of Chaos: Discovering Simplicity in a Complex World*, New York: Viking.

D'Aveni, R. A. (1994), *Hypercompetition: Managing the Dynamics of Strategic Maneuvering*, New York: Free Press.

Ehrlich, P. R., and P. H. Raven (1964), "Butterflies and Plants: A Study in Coevolution," *Evolution*, 18, 586-608.

Eisenhardt, K. M. (1989), "Making Fast Strategic Decisions in High-Velocity Environments," *Academy of Management Journal*, 32, 543-576.

Eisenhardt, K. M. (1995), "Towards a Theory of Decisionmaking in Fast-Moving, Competitive Environments," presented at the Organization Science Winter Conference, Snowmass, Colorado.

Eisenhardt, K. M., and L. J. Bourgeois (1988), "Politics of Strategic Decision Making in High-Velocity Environments: Toward a Midrange Theory," *Academy of Management Journal*, 31, 737-770.

Eisenhardt, K. M., and B. N. Tabrizi (1995), "Accelerating Adaptive Processes: Product Innovation in the Global Computer Industry," *Administrative Science Quarterly*, 40, 84-110.

Feeny, P. P. (1975), "Biochemical Coevolution Between Plants and Their Insect Herbivores," in L. E. Gilbert and P. H. Raven (Eds.), *Coevolution of Animals and Plants*, Austin, TX: University of Texas Press, 3-19.

French, W. L., C. H. Bell, Jr., and R. A. Zawacki (1994), *Organization Development and Transformation*, Burr Ridge, IL: Irwin.

Futuyma, D. J., and M. Slatkin (Eds.) (1983), *Coevolution*, Sunderland, MA: Sinauer.

Gersick, C. L. (1994), "Pacing Strategic Change: The Case of a New Venture," *Academy of Management Journal*, 37, 9-45

Hannan, M. T., and J. Freeman (1984), "Structural Inertia and Organizational Change," *American Sociological Review*, 49, 149-164.

Hannan, M. T., and J. Freeman (1977), "The Population Ecology of Organizations," *American Journal of Sociology*, 83, 929-984.

Hannan, M. T., and J. Freeman (1989), *Organizational Ecology*, Cambridge, MA: Harvard University Press.

Heckscher, C., R. A. Eisenstat, and T. J. Rice (1994), "Transformational Processes," in C. Heckscher and A. Donnellon (Eds.), *The Post-Bureaucratic Organization*, Thousand Oaks, CA: Sage, 129-177.

Hempel, K. G. (1965), *Aspects of Scientific Explanation*, New York: Free Press.

Hunt, L. (1988), *Keys to Successful Quick Printing*, Port St. Lucie, FL: Coast Publishing.

Hunt, S. D. (1991), *Modern Marketing Theory: Critical Issues in the Philosophy of Marketing Science*, Cincinnati, OH: South-Western.

Hunt, S. D. (1994), "On the Rhetoric of Qualitative Methods: Toward Historically Informed Argumentation in Management Inquiry," *Journal of Management Inquiry*," 3, 221-234.

Hutchinson, G. E. (1957), "Concluding Remarks," *Cold Spring Harbor Symposium on Quantitative Biology*, 22, 415-427.

Kets de Vries, M. F. R., and D. Miller (1984), *The Neurotic Organization*, San Francisco: Jossey-Bass.

Lawrence, P. R. (1954), "How to Deal With Resistance to Change," *Harvard Business Review*, May-June, 1954, 49-57.

Lawrence, P. R., and J. W. Lorsch (1967), "Differentiation and Integration in Complex Organizations," *Administrative Science Quarterly*, 12, 1-47.

Levins, R. (1968), *Evolution in Changing Environments*, Princeton University Press, Princeton, NJ.

Lewin, K. (1947), "Quasi-Stationary Social Equilibria and the Problem of Permanent Change," from "Group Decision and Social Change," in T. M. Newcomb and E. L. Hartley (Eds.), *Readings in Social Psychology*, New York: Holt, Rinehart and Winston.

Lincoln, Y. S. (Ed.) (1985), *Organization Theory and Inquiry*, Newbury Park, CA: Sage.

Lippman, S. A., and R. P. Rumelt (1982), "Uncertain Imitability: An Analysis of Interfirm Differences in Efficiency Under Competition," *Bell Journal of Economics*, 13, 418-438.

MacArthur, R. H. (1972), *Geographical Ecology: Patterns in the Distribution of Species*, Princeton, NJ: Princeton University Press.

Mahoney, J. T. (1993), "Strategic Management and Determinism: Sustaining the Conversation," *Journal of Management Studies*, 30, 173-192.

McKelvey, B. (1982), *Organizational Systematics*, Berkeley, CA: University of California Press.

McKelvey, B. (1994), "Evolution and Organizational Science," in J. A. C. Baum and J. V. Singh (Eds.), *Evolutionary Dynamics of Organizations*, New York: Oxford University Press, 314-326.

McKelvey, B. (1995a), "Complexity vs. Selection Among Coevolutionary Firms: Factors Affecting Nash Equilibrium Fitness Levels," working paper, Anderson School, UCLA, Los Angeles.

McKelvey, B., (1995b), Part I—Absorbing Stochastic Idiosyncrasy: Scientific Realism, Value Chain Coevolution, and Directive Correlation Envelopes," working paper, Anderson School, UCLA, Los Angeles.

Miller, D. (1990), *The Icarus Paradox*, New York: HarperBusiness/HarperCollins.

Miller, D., and P. H. Friesen (1984), *Organizations: A Quantum View*, New York: Prentice-Hall.

Mises, L. von (1963), *Human Action, a Treatise on Economics* (new rev. ed.), New Haven, CT: Yale University Press.

Montgomery, C. A., B. Wernerfelt, and S. Balakrishnan (1989), "Strategy Content and the Research Process: A Critique and Commentary," *Strategic Management Journal*, 10, 189-197.

Mosakowski, E., and B. McKelvey (1995), "Entrepreneurial Capability and the Resource-Based View of Strategy: Predicting Rent Generation Under Ambiguity," working paper, Anderson School, UCLA, Los Angeles.

Mottur, A., and Associates (1995), "Changing Organizational Form: Practical Approaches," presented at the Organization Science Winter Conference, Snowmass, Colorado.

Nei, M. (1987), *Molecular Evolutionary Genetics*, New York: Columbia University Press.

Nelson, R. D. (1994), "The Co-Evolution of Technology, Industrial Structure, and Supporting Institutions," *Industrial and Corporate Change*, 3, 47-64.

Odum, E. P. (1971), *Fundamentals of Ecology* (3rd ed.), Philadelphia: Saunders.

Odum, E. P. (1993), *Ecology and Our Endangered Life-Support Systems*, Sunderland, MA: Sinauer Associates.

Perrow, C. (1994), "Pfeffer Slips," *Academy of Management Review*, 19, 191-194.

Pfeffer, J. (1982), *Organizations and Organization Theory*, Boston, MA: Pitman.

Pfeffer, J. (1993), "Barriers to the Advancement of Organizational Science: Paradigm Development as a Dependent Variable," *Academy of Management Review*, 18, 599-620.

Pianka, E. R. (1994a), *Evolutionary Ecology* (5th ed.), New York: Harper and Row.

Pianka, E. R. (1994b), *The Lizard Man Speaks*, Austin, TX: University of Texas Press.

Popper, K. R. (1959), *The Logic of Scientific Discovery*, New York: Harper and Row (German version, 1935).

Porras J. I., and R. C. Silvers (1991), "Organization Development and Transformation," *Annual Review of Psychology*, 42, 51-78.

Porter, M. E. (1985), *Competitive Advantage*, New York: Free Press.

Porter, M. E. (1990), *Competitive Advantage of Nations*, New York: Free Press.

Porter, M. E. (1991), "Towards a Dynamic Theory of Strategy," *Strategic Management Journal*, 12, 95-117.

Prahalad, C. K., and G. Hamel (1990), "The core Competence of the Corporation," *Harvard Business Review*, 68, 78-91.

Romanelli, E., and M. L. Tushman, (1994), "Organizational Transformation as Punctuated Equilibrium: An Empirical Test," *Academy of Management Journal*, 37, 1141-1166.

Rosenkopf and Tushman, (1994), "The Coevolution of Technology and Organization," in J. A. C. Baum and J. V. Singh (Eds.), *Evolutionary Dynamics of Organizations*, New York: Oxford University Press, 403-424.

Rudner, R. (1966), *Philosophy of Social Sciences*, Englewood Cliffs, NJ: Prentice-Hall.

Salmon, W. C. (1971), *Statistical Explanation and Statistical Relevance*, Pittsburgh, PA: University of Pittsburgh Press.

Sanchez, R. (1993), "Strategic Flexibility, Firm Organization, and Managerial Work in Dynamic Markets," *Advances in Strategic Management*, 9, 251-291.

Simpson, J. A., and E. S. C. Weiner (Eds.) (1989), *The Oxford English Dictionary* (2nd ed.), Oxford: Clarendon/ Oxford.

Smith, F. E. (1970), "Analysis of Ecosystems," in D. Reichle (Ed.), *Analysis of Temperate Forest Ecosystems*, Berlin: Springer-Verlag, 7-18.

Sommerhoff, G. (1950), *Analytical Biology*, London: Oxford University Press. (Chapter 2 reprinted as "Purpose, Adaptation and 'Directive Correlation,'" in W. Buckley (Ed.), *Modern Systems Research for the Behavioral Scientist*, Chicago: Aldine, 281-295.

Spendolini, M. (1992), *The Benchmarking Book*, New York: Amacom.

Stalk, G., and T. M. Hout (1990), *Competing Against Time*, New York: Free Press.

Suppe, F. (1977), *The Structure of Scientific Theorie*s (2nd ed.), Chicago: University of Chicago Press.

Suppe, F. (1989), *The Semantic Conception of Theories & Scientific Realism*, Urbana-Champaign, IL: University of Illinois Press.

Teece, D., G. Pisano, and A. Schuen (1994), "Dynamic Capabilities and Strategic Management," CCC Working Paper # 94-9, UC Berkeley, Berkeley, CA.

Thompson, J. N. (1989), "Concepts of Coevolution," *Trends in Ecological Evolution*, 4, 179-183.

Tichy, N. M., and S. Sherman (1993), *Control Your Destiny* or *Someone Else Will*, New York: HarperBusiness/HarperCollins.

Tushman, M. L., and E. Romanelli (1985) "Organizational Evolution: A Metamorphosis Model of Convergence and Reorientation," *Research on Organizational Behavior*, 7, 171-222.

Tushman, M. L., and P. Anderson (1986), "Technological Discontinuities and Organizational Environments," *Administrative Science Quarterly*, 31, 439-465.

Van de Ven, A. H., and R. Garud (1994), "The Coevolution of Technical and Institutional Events in the Development of an Innovation," in J. A. C. Baum and J. V. Singh (Eds.), *Evolutionary Dynamics of Organizations*, New York: Oxford University Press, 425-443.

Van Valen, L. (1973), "A New Evolutionary Law," *Evolutionary Theory*, 1, 1-30.

Weick, K. E. (1985), "Sources of Order in Underorganized Systems: Themes in Recent Organization Theory," in Y. S. Lincoln (Ed.), *Organizational Theory and Inquiry*, Newbury Park, CA: Sage.

Watson, G. H. (1993), *Strategic Benchmarking*, New York: Wiley.

Wernerfelt, B. (1984), "A Resource-Based View of the Firm," *Strategic Management Journal*, 5, 171-180.

Zaltman, G., and R. Duncan (1977), *Strategies for Planned Change*, New York: Wiley.

Figure 1

Essential Typological Attributes

Phase States		Attributes					
		No Change	Known Best Practice	Lippman/ Rumelt	Opaqueness and Barriers	Product *FC*s	Life-Cycle Jumping
	Alpha	X					
	Beta		X				
	Gamma			X		X	
	Delta			X	X		
	Zeta			X		X	X