A Nonequilibrium, Nonlinear Approach to Organizational Change

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[Abstract: Equilibrium models of organizational change are contrasted with a new model derived from nonequilibrium, nonlinear, and dynamical systems research. Kurt Lewin's force-field theory is used as an example of the traditional equilibrium-seeking model. The characteristics of the new model are: nonlinearity; change in attractors; environmental gradience and nonequilibrium constraints; internal gradience; bifurcation; and self-organization. Advantages of the new model are described.]

When we lose our balance we die, but at the same time we also develop ourselves, we grow... Shunryu Suzuki Roshi

In the context of the endemic turbulence faced by American businesses and institutions, this paper offers an approach to organizational change derived from nonequilibrium, nonlinear, dynamical systems research. This approach extends and amplifies previous suggestions into a new model (see Bigelow 1982; Ciborra, et. al. 1984; Gemmill and Smith 1985; Goldstein 1988; Nonaka 1988).

Traditional Models of Organizational Change

Theories on organizational change can be separated into three categories (see Sluzki 1983):

1.) **Structural:** changes in structure including power relationships, hieararchies, or classes (Hernes 1976; Marx, et. al. 1970; Miller 1982; Minuchin 1974). Since,these approaches share assumptions about systems with the third category below, our reevaluation of the equilibrium-seeking concept will also apply to these models.
2.) **World-views:** changes in "paradigms", beliefs, or corporate culture (see Bartunek 1984; Bartunek and Moch 1987; Sheldon 1980; Watzlawick 1974). We will show that our new approach can account for these cognitive shifts.
3.) **Equilibrium:** change as a shift from one equilibrium state to another. Since <u>non</u>equilibrium research reconsiders many of the underlying suppositions of equilibrium-seeking, we shall examine this third category in greater depth. The "ultra-equilibrium" of autopoeisis (Maturana and Varela 1980; also see Goldstein 1988, 18-20) and ultrastability (Ashby 1968, 115; Beer 1981, 28,36; Cadwalader 1968, 438, 439) are not considered since they do not address the dynamics of change itself--e.g. Maturana and Varela cursorily mention structural change but their main concern is the <u>nonchanging</u> nature of autopoeisis.

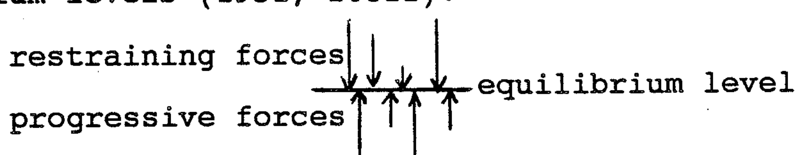
The Equilibrium-seeking Model and Organizational Change

Russett surveyed several prominent social theories founded on systemic equilibrium-seeking as formulated in physics (1966; see also the present author's article on Freud in this volume for the role of equilibrium models in 19th century physics). Thus, Pareto conceived a social system's resistance to change as equilibrium-seeking (Timasheff 1976, 133). Equilibrium was the balance of the forces prodding change, the forces of cohesion in the system, and the forces of inertia (see Sorokin 1941, ftn 8, 671). Henderson popularized Pareto's ideas in America, claiming the equilibrium model insured a social system's predictability (Henderson 1935, 114). Lundberg declared that the quest for parsimony in science is derived from equilibrium-seeking (Lundberg 1964, 100).

Social change, according to Pareto, was an incremental transition of equilibria states (Russet 1966, 93). Parsons added that change was "alteration by the overcoming of resistance" resulting from social institutions or "vested interests" maintaining their hegemony (Parsons 1951, 491). Social strain can upset this equilibrium, but the eventual outcome is a "re-equilibration" (Parsons 1951, 491, 492, 520). Simon's believed that reform movements upset equilibrium causing a "shift in initial conditions to permit the system to move toward a new equilibrium with a different stable constellation of forces" (Simon 1954, 405).

Lewin's Equilibrium Force Field and Organizational Change

The most rigorous theory of moving equilibria emerged in the social-psychology of Kurt Lewin who viewed organizations as "force fields" in which opposing forces balance each other at quasi-stationary equilibrium levels (1951, 203ff):



Planned change "consists of supplanting the force field corresponding to an equilibrium at the beginning level... by a force field having its equilibrium at the desired level" (Lewin 1951, 224). This can be accomplished by <u>linearly</u> adding force to one side:

> We know that the resultant force on a present level L is zero ($f^*_{L,\infty}=0$). Adding the force $/f_{L,n}/>0$ should move the level in the direction of n to a different level($L+\Delta$) The amount of change Δ is determined by the equation /f*(L+), L/=/f L, n/ (Lewin 1951, 224,225)

Lewin warned that this process was often insufficent: "historic constancy creates an 'additional force field' which tends to keep up the present level in addition to whatever other forces are keeping the social process at that level" (1951, 225). Like Parsons, Lewin equated this "additional force field" with "vested interests", institutions, and "social habits (such as production standards).

It was necessary to "unfreeze" these additional force fields by way of catharsis, emotional stirring-up, or group participation

(Lewin 1951, 230). Group participation "unfreezes" by subordinating the individual's will to the group will or by reinforcing the decision linking individual motivation to action. "Refreezing" the new state is also necessary (Burke 1987, 58).

Characteristics of the Equilibrium Model

1. Organizations are equilibrium-seeking systems.
2. The stability and order of an organization is due to its equilibrium-seeking (see Wheeler 1962, 74).
3. Change is seen a shift from one equilibrium state to another. The posited transitional disequilibrium is left unexamined.
4. Resistance to change is due to "additional force fields". This resistance must be "unfrozen". The new state is to be "refrozen".

Problems with the Equilibrium Model

Equilibrium-seeking is incompatible with change. Dell faulted theories of homeostasis (1982, 27): "if homeostasis is understood as something that maintains the status quo..then when the system evolves to a different way, homeostasis is unable to account for it." Indeed, the equilibrium model in physics was directed toward understanding <u>stability</u> on the basis of systemic constants (D'abro 1939). Therefore, the equilibrium-seeking model is not about change, it's about stability (see Timasheff 1976, 270). Sorokin claimed that the equilibrium model couldn't answer these questions concerning the transition from one equilibrium state to another (1941, 682, 683):

1. Where and what exactly are these external disturbing forces?
2. What accounts for the time length needed by these disturbing forces in breaking down equilibrium? Why not sooner or later?
3. How do these forces become dominant at a given moment?
4. Why does one equilibria state replace another, ie, why isn't the first state just broken-up into a state of chaos (sic)?
5. Has this replacement been due to some internal changes in the system, or to a certain combination of external conditions?

The phenomenology of social processes. Merton warned: "...does the prevailing concern among functional analysts with the concept of **social equilibrium** divert attention from the phenomena of **social disequilibrium**" (Merton 1949, 53, his emphasis). Similarly, Easton didn't believe the equilibrium model was true to the phenomenology of social change: a society will not just react to a disturbance by oscillating around some equilibrium--instead it may seek to change the environment, or go into further isolation, or transform relationships, goals, and practices (1968, 430). Dell suggested that because a system continues to exist unchanged doesn't signal it is resisting change, it just means that the system as it now exists is still fitting its environment: "its environmental input... has contained nothing that is disruptive to the systemic organization...the sytem... just goes on being itself" (1982, 29).
Assumption of Linearity. Besides positing a <u>direct proportion</u> among

system elements, linear superposition claims a complex system can be segmented into simple components in order to understand the components separately, and then be recombined back into an organized whole that can be understood in terms of the properties of the components (West 1985. 70). Change in a system is, then, a linear superposition of the changes of the elements (West 1985, 60).

An implication of the linear model is that "all deviations from linearity in the interacting motions of a system were assumed to be treatable by perturbation theory" (West 1985, 73). Moreover, West linked linearity with the isolation of a system from its environment: "The coupling of a system to the environment can only be made arbitrarily weak when the coupling is independent of the system. If the coupling is dependent on the system's processes, then for some values of the quantities characterizing the system the coupling to the background cannot be ignored. Such a system dependent coupling is therefore nonlinear" (1985, 67). Going beyond linear limitations, "qualitative" mathematics can focus on properties of the nonlinear interaction of the system, its parts, and the environment (see Goerner 1989, 9,10).

A Nonequilibrium, Nonlinear Approach to Systemic Change

Research has shown that nonequilibrium conditions may lead to systemic change not explainable with equilibrium-based models. (see the section "An Example of Far-from-equilibrium System Dynamics" in the paper on Freud in the current volume.) The major features of nonequilibrium, nonlinear systemic change can be applied to organizational change:

1. Organizational systems are defined by nonlinear relationships among their elements and between the system and the environment. The Benard system is nonlinear: "the transport of the property, like for instance, energy, is carried by the motion itself, whose velocity is one of the variabilities to be determined" (Nicolis 1989,330; see Berge, et al 1984, 90, 91 and Swenson 1989). In the Belousov-Zhabotinsky reaction, autocatalysis is nonlinear since a reactant's presence enhances the rate of its production. At equilibrium conditions, this nonlinearity may not be evident macroscopically (see Swenson 1989). Nonlinearity in organizations shows up in analogous processes. Thus, nonlinearity as the result of mixed feedback loops has long been a tenet of system dynamics (Forrester 1975a). These feedback loops bring "results from past actions of the system back to control future action" (Forrester 1968, 1-5). Richardson has pointed out the similarity of Forrester's feedback concept to other social science models: Myrdal's principle of cumulation, Merton's self-fulfilling prophecy, Bateson's cybernetics, and the Bounded Rationality of Herbert Simon (1983, 7,11,12,21). Nicolis has remarked that non-linearity in human populations may reflect processes of growth, communication, competition,or information exchange (1989, 330). In family systems theory, Bateson's concept of feedback has long been a staple for understanding family member behavior (1972). Watzlawick has presented a similar nonlinear conception with his "vicious-circle" in which the very solution to a problem escalates the intensity of the problem (1974, 32). Eisler and Loye link Prigogine's concepts to the classic social theories of Durckheim and Weber (1987, 59).

Moreover, organizational autopoeisis is nonlinear in a sense comparable to West's point about nonlinearity in a system's coupling with its environment: the environment is "created" by the identity of the system (see Goldstein 1988, 18,19; Hejl 1984, 60-79; Morgan 1986, 233-246). Moreover, the unchanging nature of autopoeisis can be attributed to the stable robustness of coupled nonlinear systems (see Abraham and Shaw 1984, 171; Glass and Mackay 1988, 25, 32; Gleick 1987, 48,193: Sterman 1988, 173; West 1985, 193). Perhaps, Lewin had intimations of the essential nonlinear nature of social systems in his postulation of an "additional force field". In our new model, nonlinearity obviates the need for Lewin's additional force fields, an accouterment violating Occam's Razor.

1a. Organizational nonlinearity is revealed at nonequilibrium conditions. At equilibrium, nonlinearities are present but irrelevant since, after a sufficient lapse of time, there is no evolution away from the equilibrium state (Nicolis 1981, 202). The relation of the variables only appears linear at equilibrium because nonlinear terms can drop out--near bifurcation these nonlinear terms are revealed in the phenomenology of the organization.

1b. Organizational nonlinearity has the potential for organizational change under appropriate nonequilibrium conditions. This follows from the fact that nonlinear systems contain their own seeds of change as parameters are changed. This change can be portrayed as changes in attractors in phase space (see Abraham and Shaw 1982). Attractors portray the eventual convergence of the behavior of a system into a particular pattern when transients die away, and express relations among system elements <u>independently</u> of the initial conditions (Feigenbaum 1983, 20). A mathematical example is the logistic equation for studying population dynamics: **X(t+1)= aXt(1-Xt)** where **a** is a parameter (or constraint on the system), **Xt** is the current population, expressed as a % of maximum population, and **X(t+1)** is the population at time **t+1** (May 1987, 29;). The nonlinearity is evident by expressing the equation as $aX_t - aX_t^2$. Functional iteration takes place in which the result is pumped back into the equation and repeated (see Feigenbaum 1983). Moreover, this equation can be expressed in feedback formulations (Peterson 1988, 149; also see Goerner 1989a). As the parameter increases, the essential nonlinearity becomes evident and the attractors change: for **3>a>1**, there is a fixed point attractor (this is the only possible attractor in a linear system (Mosekilde, et al, 1988, 21); at **a=3** the system bifurcates to the rulership of a period two attractor which dominates the system until **1+ /6>a>3**; as **a** increases beyond this value, successive bifurcations occur each with an attractor double the period of the previous one; beyond this, at **4>a>3.570...**, "chaos" sets in, in the midst of which "windows" of stability appear with stable periods. The point is that <u>the nonlinearity expressing the relationships among the elements of the equation can account for the transformation of the solutions as the</u>

parameter is increased. Nicolis points out that the coexistence of multiple attractors constitutes the natural model of systems capable of adaptive change (Nicolis 1989, 332). Nonlinearity doesn't insure change, but under the right conditions it can lead to change.

2. **Organizational Change is a nonlinear dynamical transition of attractors not equilibrium states.** Looking at the shape and dynamics of attractors in phase space enables one to see the envolving relationships among the elements of the system. Emphasizing attractors in a dynamical perspective puts the onus of understanding change on the qualitative, topological properties of attractors. Each attractor is associated with at least one mode of behavior of the system, therefore, by classifying attractors we obtain insight into the types of behavior a system can show over time. Also, an implication is that Sorokin's questions #2,3,4 about equilibrium explanations can be answered by appeal to qualitative mathematics.

2a. **Equilibrium-seeking is a description about organizational systems under the attraction of a fixed point for static equilibrium or periodic attractor for moving equilibrium** (Crutchfield, et. al. 1986). But this is only a partial arc of the system's life trajectory-- therefore, equilibrium-seeking can't be an ultimate explanation of organizational change. Systems can have stable and unstable equilibrium, eg. dissipative structures can be said to be stable or steady-state nonequilibrium (see Corning 1983).

3. **Boundary Conditions form a "container" for the organizational sytem.** In the Benard convection the distance separating two neighboring currents is on the order of the vertical height of the container (Berge, et.al.1984, 85,86). The number of convection rolls can be curtailed by reducing the ratio of horizontal dimension to vertical height. Instabilities in the thermal boundaries of liquid systems similar to the Benard system lead to more complicated kinds of convection (Weiss 1987, 72). Thus, boundary conditions maintain a closure so that the system can be effected by the environment without this effect just passing through the system and out the other side gradience (see Varela 1984). This closure is not a purely "closed" system--it can be effected by environmental gradience.

4. **A gradient environment induces gradience inside the embedded organizational system.** Schrodinger made the point that an isolated system is equivalent to a system placed in a uniform environment (Schrodinger 1968, 144). But, organizations don't dwell in uniform environments and they are not purely isolated systems. The implication is that a nonuniform or gradient environment may induce a nonequilibrium in the embedded system in which nonequilibrium and exchange with the environment maintain each other .

In a linear model such as Lewin's, to ascertain which gradience would be necessary to effect organizational change should be a matter of determining the factors in equilibrium and adding a change force to one side of the balance. For example, in the Benard system, at equilibrium conditions, the following forces are in balance: on one side there is the viscosity of the liquid plus the "smoothing" ability of diffusion; on the other side is the gravitational propensity to density gradients to start convection currents. But Lewin's model doesn't work here since the Benard system is stable not because the forces are in balance--it is stable because the range of parameters of the nonlinear differential equation defining the relationships among the variables in the system is within the range of a fixed point attractor. The attractor determines that the statistically preferred state would be the equilibrium state. Stability follows from this attractor, it doesn't cause it. (Stability and instability are functions of which "phase" the nonlinearity is in). Near bifurcation stable equilibrium becomes unstable. A gradient environment does this by two parallel effects.

4a. First, a gradient environment can act as a nonequilibrium constraint keeping the organization from settling into equilibrium. This consis on the equilibrium-seeking not a "pressure" on the system to change; it is analogous to increasing the parameter **a** in the logistic equation. This effect can be a natural result of being in a nonuniform environment or it can be result of an experimentally applied nonequilibrium constraint. In either case, the system is moved away from stability. For example, in the Benard system, the environmental gradient is heat added to one part of the system. As long as the temperature change is kept low, equilibrium conditions remain and the behavior of the system stays within the confines of a fixed point attractor. But, as the environmental gradient of temperature is increased, nonlinearity becomes evident, dand a new attractor emerges.

4b. Second, the gradient environment leads to gradience within the organizational system activating the nonlinear potential for change. Swenson speaks of this internal gradience as the gap between a source and a sink which the system thermodynamically seeks to close (Swenson 1989). In the Benard system, the external heat gradient causes internal temperature and density gradience, which is then amplified by the nonlinearity revealed in the far-from-equilibrium condition. Adding dye would not have this effect because the nonlinearity of the system would not be involved.

These two effects (4a and 4b) can also be seen in the Belousov-Zhabotinsky reaction, in which the nonequiilibrium constraint is the decreasing of the residence times of the chemical reagents--shorter residence times keep the system from chemical equilibrium (Nicolis 1989, 321). Also, this shorter residence time is the breaking of time symmetry, ie a time gradient, which is amplified by the nonlinearity of the reaction's autocatalysis (Nicolis 1989, 320).A gradient temperature environment would not have had this effect.

4c. The same organizational processes which maintain stability at equilibrium can become destabilizers at far-from-equilibrium because of nonlinearity. The gradience must have the possibility of effecting the stability of the system. In the BZ reaction, at equilibrium conditions with long residence times, nonlinear autocatalysis acts to maintain chemical equilibrium (Prigogine and Stengers 1984, 145). But, far-from-equilibrium, the time gradience of residence times is enhanced by autocatalysis.

Forrester has made the point that there are certain nodal points where a system can be changed (1975b, 220). Self-fulfilling, vicious circles in organizations (ie, organizational "autocatalysis") have bifurcating potential since stable equilibrium can become unstable and little changes can have big effects (akin to "sensitivity to initial conditions" in chaos theory, see Crutchfield, et. al. 1986).

Nonlinearity explains why Lewin had to postulate the supplementary, resisting "additional force fields". A nonequilibrium constraint is different than the linear addition of a force to one side of a stable balance. If anything heat could be a factor on the side opposite convection, ie, thermal diffusion--then why does convective self-organization happen? Instead the nonequilibrium constraint doesn't change the system itself--eg, in the Benard system, it creates a density gadience which, displaced vertically by random fluctuations, is amplified by gravity and the result is the self-organization seen in convection rolls. **Gradience prompts self-organization through the action of the transport of heat as well as gravity at the bifurcation point.** Change is released not imposed, for imposition will usually only result in compensating feedback. Lewin's linear force field can't account for the phenomena of self-organization since it doesn't allow for a nonlinear effect on gradience. Moreover, "unfreezing" is really the wrong metaphor for it refers to a phase transition--the change of ice to water which Nicolis indicates is a local intermolecular effect, not the global change seen in self-organization (1989, 329). What Lewin saw take place with groups may be more like self-organization than a phase transition.

The increasing internal gradience of an organizational system can also be conceptualized as the increase of information in the system. This follows from Bateson's point about information as "differences" that make a "difference" (1974). The introduction of new information into an organization by way of "difference questioning" or other techniques can be conceptualized as the internal gradience effect of a nonequilibrium environment (see Goldstein 1988; Nonaka 1988).

It is important to point out that this internal gradience does not leave the system in a polarized state with distinguished elements inaccessible to each other. Instead, in self-organization, the gradience is "integrated" in a correlated, global fashion.

5.) Bifurcation to a new attractor marks organizational change. Bifurcation, marking a change in the global configuration of the organizational system, is the appearance of new physical solutions to the underlying nonlinear equations of systemic evolution (Nicolis 1981, 197,198). From a dynamical systems perspective, this transformation is a shift in attractors (Crutchfield, et al 1986; Libchaber 1987; Swinney 1983; Thompson and Stewart 1986). At bifurcation, nonlinear relationships are revealed since linear approximations no longer work. Also, bifurcations are essential to catastrophe theories of organizational change (see Bigelow 1982). The mathematics of bifurcation phenomena can answer Sorokin's earlier questions about transitions from equilibrium. Bifurcation happens when the system becomes unstable, meaning its regime under an attractor can no longer satisfy the maximal production of entropy demanded by the Second Law of thermodynamics--the new attractor that emerges enables maximal entropy production in the face of the gradient conditions. In system dynamics models, bifurcation instability can be associated with types of negative or positive feedback (Mosekilde, et al 1988, 19).

6.) The amplification of organizational fluctuations or "noise". Nonlinearities enable fluctuations to be amplified and "invade" the whole system. This is not just deviation amplification (see Maruyama 1968) for in a system dominated by equilibrium-seeking, deviation-amplification will kick-in a compensating equilibrium seeking process (see Forrester 1968). But, in the Benard liquid, a weak perturbation is magnified at bifurcation to the extent that the system is ushered into a new qualitative dynamical state.

In equilibrium conditions, fluctuations are statistically insignficant which enables them to be "ignored" by the system. But in far-from-equilibrium conditions, fluctuations can reach the same order of magnitude as the mean macroscopic values in the system so that these fluctuations can't even be distinguished from macroscopic system elements (Prigogine and Stengers 1984, 180). That is why they can no longer be "ignored" by the system--self-organization "incorporates" these fluctuations or "noise" into its new way of being organized (Ciborra, et.al. 1984; Nonaka 1988). Moreover, the larger the fluctuation, ie, its distance from equilibrium, the lower the gradience or nonequilibrium constraint that is needed to induce a situation a nonlinear amplification of the fluctuation at bifurcation (Hanusse, Ortoleva, and Ross).

6a. Organizational change is a cooperation between chance and determinism. Nicolis states:

> Nothing in the description of the experimental set up permits the observer to assign beforehand the state that will be chosen. Only chance will decide, through thedynamics of fluctuations. The system will 'scan theground', will make a few attempts, perhaps unsuccessfully at the beginning, and finally a particular fluctuation will take over. By stabilizing it, the system will become a historical object in the sense that its subsequent evolution will depend on this critical choice (Nicolis 1989, 342).

6b. Amplification of fluctuations may provide the organization with a more effective way of achieving its "purpose". By means of fluctuations, the Benard system "tests" several configurations and finds one (the convection cells) which can transport heat in the most effective way (see Haken 1984, 36). In this way, the taking advantage of chance by using it to explore different system configurations may represent an evolutionary, adaptive response of the organization to an environmental change (see Allen 1988, 120, 1299). A corollary adaptive process is microscopic diversity in system evolution (Allen and McGlade 1987).

7.) Organizational change may lead to self-organization expressing greater coherence, order, stability, and complexity. At equilibrium conditions correlation between elements is statistical (Prigogine and Stengers 1984, 180). But, far-from-equilibrium conditions in a nonlinear system may lead to self-organization in which "communication" in the system ... keeps the coherence from being drowned out by the system's "noise" (Nicolis 1989, 340; for a similar phenomena in organizations see Gemmill and Smith 1985). This is also an increase in complexity because of the number of links between the different subunits described by the differential equations of evolution (Prigogine, et. al. 1976).Self-organization means that elements in the system are expressing a new pattern of relationship, a new configuration of elements expressing a robustness in the face of perturbations (Abraham 1984, 171,Haken 1980; Haken 1981).-in the Benard system this has to do with temperature, spatial structure, and velocity of convection currents. These factors are now cooperating in a fashion that didn't exist before. This pattern is the result of an internal selection of "microstates" or restructuring in order to effect a maximum entropy production thus staying within the bounds of the Second Law of Thermodynamics (see Swenson 1989).

Self-organization follows from the idea of social domains: " ... social domains ... allow for coordinated behavior and for communication...it becomes understandable that individuals...behave differently inside and outside a social domain...all components of social systems have direct access to the environment of the whole system..."(Hejl 1984, 69,76).

Advantages of the New Model

In the old model, change was explained in terms of stasis, disequilibrium in terms of equilibrium, and nonlinearity in terms of linearity. In the new approach, linearity is seen as an approximation at equilibrium conditions, but is inadequate to describe the evolutionary nature of the nonlinear system in the face of gradient environments. The new approach sees organizational systems as primarily changing systems. Any particular phase of the system, such as an equilibrium-seeking regime, is seen as a partial arc in this longer range life trajectory of the system.

Sorokin remarked that "equilibrium" connoted harmony, adjustment, normalcy, whereas disequilibrium was disharmony, maladjustment, and pathology (1941, 683). Disequilibrium was an aberration, explained only in reference to its background, ie, equilibrium. This was taken to its extreme with Cannon's arch conservative political implications of homeostasis (1932, 305-324). The new model doesn't have this problem, for nonequilibrium and nonlinearity now connote creative adaptation to a changing environment. Furthermore, since the environments of organization are rarely uniform, equilibrium conditions are also rare--more common would be the effect of gradient environments as nonequilibrium constraints on equilibrium-seeking.

Moreover, in the new model, bifurcation shows the kind of global paradigm shift of the second category of theories (see Bartunek and Moch 1987, for their account of sudden shifts in "2nd order" change). In the old model, transition from one equilibria state to another would only be a "first order change". In the new model, unique characterisics of attractors can account for belief system shifts whereas global level effects could not take place with a linear model--the old model is usually piecemeal (see Miller 1982).

Moreover, in the equilibrium model, the external is the locus of change (Sorokin 1941, 691, 692). This suggests the system lacks its own inner resources for transformation or development. The new model has two foci of change: external (nonequilibrium constraint) and internal: self-organization as a spontaneous, internal adaptation to a changing environment. In the new model, change is the revelation of internal nonlinearities. The forces for change are already present.

Furthermore, unlike the old model, big changes don't necessarily need big interventions. Corresponding to the property of sensitivity to initial conditions, in which nonlinearity can amplify small changes, a gradient environment can lead an organizational system to a point where bifurcation happens with the amplification of perturbations (see Crutchfield, et. al.1986). In this way, the new approach takes advantage of chance and diversity. Organizational "random noise" is no longer something that just needs dampening, it can be a source of creative change (see Ciborra, et. al. 1984; Nonaka 1988; and, on a personal level, Austin 1978).

Unlike the old model the new model does not have to appeal to the following explanatory agencies:

1. resistance to change and agencies responsible for this resistance like "additional force fields".
2. "unfreezing" this resistance.
3. "refreezing" the new equilibrium state by persuasion, manipulation, coercion, or even reward. (Nonlinearity insures that at appropriate conditions, change is something that is **released**, it doesn't need reinforcement).
4. imposition of new organizational structures or policies to accomplish "refreezing".

If an organization doesn't change eventhough an environmental change was introduced (ie, a nonequilibrium constraint) this can mean two things: the values of the constraint are not sufficient to show the nonlinearities; the constraint is of the wrong nature in that it isn't leading to the necessary internal gradience destabilizing equilibrium. With this formulation, there is the possibility of predicting organizational change depending on the nonlinear equations as well as the values of the nonequilibrium constraint or gradience. The stability of the system has to be determined, eg, the autocatalytic, vicious circle, and the nonequilibrium constraint must be applied there. Again, the constraint isn't <u>causing</u> the change, the nonlinearities are being revealed and released.

Conclusion

Using this new model leads to a new set of questions guiding organizational change: What are the nonlinear relationships in the system? What is in equilibrium in the system? What constraint would lead to the system departing from equilibrium? What type of gradience would the system require to release the change potential of the nonlinear relationships? What fluctuations could be amplified? Where are the places of autocatalytic, recursive, iterative processes which could lead to amplification?

These are a different set of questions than the usual ones guiding the role of change agents (see Goldstein 1988; and Nonaka 1988). In the new model, change is something potentially present in the system,which is revealed under the right conditions. The change agent is a mediator of a gradient environment. The environment is allowed to effect the sytem, as it is, without the need for persuasion or threat or manipulation. It is more organic, for if persuasion or manipulation is used it will have to be buttressed all along.

Finally, the new model of organizational change presented here corresponds with the new role of leaders emerging in the recent leadership paradigm. As the leadership theorist Ronald Heifetz put it: "Someone exercising leadership is probably generating disequilibrium... or protecting other people in the organization who are creating disequilibrium" (1988).

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