SOCIETY FOR CHAOS THEORY IN PSYCHOLOGY AND THE LIFE SCIENCES

NEWSLETTER July--August 1995 VOL 2, NO 6

29 Hayes Road Amity Harbor, NY 11701 USA ▭ *Jeffrey Goldstein, Ph.D., President*

FIFTH ANNUAL INTERNATIONAL CONFERENCE OF THE SOCIETY AUGUST 8-12, 1995 -- ADELPHI UNIVERSITY, GARDEN CITY, NY (PROGRAM AND REGISTRATION ON PAGES 4,5,6)

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ARTICLE Newton's Heifer: From Metaphor to Mechanism

George J. Mpitsos, Ph.D., Oregon State University -- The Mark O. Hatfield Marine Science Center, Newport, OR 97365; gmpitsos@slugo.hmsc.orst.edu

Abstract: Given the Society's interest in chaos, I might be permitted to say that behavioral science is naturally fractal. Discontent with the formalism that has brought it to the present state has caused it to seek to grow, analogous to the behavior of chaotic systems, into something bigger--into a higher conceptual and experimental dimension--yet that state seems always out of reach. "Chaos theory" provides a never-world of imagined happiness. This is not to say that all behavioral scientists are discontent with entrenched dogma, but many people have seen the inherent complexity, variability, and unpredictability of neural, organismal, and social behavior and realize that the old ways do not match up to the task of handling such systems. Does "chaos theory" apply? Does it help? We need to evaluate the possibility carefully.

Last year, I gave a paper (Mpitsos, 1994) at a conference on chaos and related theories applied to social systems and organizations. The attendees and speakers came from diverse areas of interest and academic backgrounds, from those dealing with resource management, organizational development, psychology, nursing and public health, counseling, economics, and many others. The talks, workshops, and discussions dealt with how "chaos and complexity theory" may apply to all of these fields of interest. One of the remarkable discoveries was to see how aggressively and happily people have taken to these notions. In one of the workshops, I commented that, despite the on-going fuzziness in the definition of what the term chaos really means, there is a considerable formalism, much of it based on studies of differential and difference equations (Hale & Kosak, 1991), that can be used to discuss it. Additionally, the work of Poincare (Abraham & Shaw, 1983), Mandelbrot (1985), Takens (1981), Packard et al. (1980), for example, have provided a formal background with which to examine the phase-space geometry of data. If we are to use the notion of chaos, or of dynamical systems theory generally, to state even that there are attractors (chaotic or not), we must first attempt to determine whether our data can be examined within the constraints that were used to generate the available tools. For example, is the data statistically stationary? Is there enough of it? Have we thought of these constraints in setting up experiments to gather the data? Such thinking is standard for anyone trained in the "hard" sciences. The reply I received was totally unexpected. It was a quiet, inquisitive, "Why? Why should data and theory match up?"

(CONTINUED ON PAGE 2)

ARTICLE Leadership is Not Normal: Nonlinear Dynamics and Self-organization in Leadership Emergence

Stephen J. Guastello, Ph.D., Dept. of Psychology, Marquette University, Milwaukee, Wisconsin 53233; 6155GUASTELL@vms.csd.mu.edu

Abstract: Contrary to common measurement practice, the frequency distribution of leadership behavior in groups was hypothesized to conform to an exponential probability density function. Ninety-four adults, who were organized into groups of 7-9 players, participated in a group problem solving exercise that began without an appointed leader. Ratings of leadership behavior by each player for each fellow player revealed that clear leaders did emerge, reflecting a form of self-organization within the group. Further analysis showed that the obtained frequency distribution was a complex exponential multimodal function generated by a swallowtail catastrophe dynamic.

The importance of identifying and developing effective leaders is crucial to most concepts of organization and society. Psychological research has contributed to the effort for nearly a century, and the variety of approaches to the study of leadership is too vast to fully review here (but see Clark & Clark, 1990; Clark, Clark, & Campbell, 1992). Although much of the work on record

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ARTICLE: Chaos, Initiation, and the Unconscious

Tobi Zausner, Ph.D. 137 East 38 Street, 6J, New York City, New York 10016; Tel: 212/686-5272; Fax: 212/686-1396

As modern psychology postulates that profound change comes from contact with the unconscious (Ellenberger, 1970), so the peoples of antiquity believed that transformation was the power of the underworld. Harding says, "The ancients knew no inner or psychological realm, to them the inner world was conceived of as the underworld" and change was a process of death and rebirth. (1971, p.114) Both the unconscious and the underworld are characterized by chaos and it is in chaos that bifurcation to a radically new order can be achieved. (Stewart, 1989) In antiquity as in present times, major personality changes have sometimes been noted in people who have gone through a period of chaos. Small changes in an individual may take place without disruption to daily routine, but a basic and abrupt ontological shift may not be possible without stress severe enough to break down some of the defenses of the conscious mind. The observation that chaos could produce a profound existential shift may have been the basis for the ritualized disequilibrium of initiation. Initiations are intentionally difficult procedures with far-from-equilibrium conditions. They can be modelled as a resetting of initial conditions into a different attractor basin. (Abraham, 1995) The purpose of an initiation is the annihilation of immaturity and the profane life and the emergence of maturity and philosophical reflection. (Eliade, 1958) Psychologically, it is a leave-taking of the personally orientated ego for a newly defined individuality. (Harding, 1971) In an initiation, a person goes through a psychological death and rebirth in order to transform themselves and their view of the world. It is usually ceremonial, involving a time of preparation, and adheres to the traditions of the society or group in which it is performed. (Eliade, 1965) In an initiation ceremony where stress may be ritualized in an attempt at uniformity, all of the initiates may undergo some form of change but each one will be transformed according to his or her own individuality. Far-from equilibrium conditions can promote the self-organizing properties of dynamical systems (Prigogine 1984) but dependence on initial conditions suggests that no two dynamical systems will act identically. (Briggs and Peat, 1989) **(CONT. P. 7)**

Newton's Heifer **(CONTINUED FROM PAGE 1)**

On the one hand, the need for proper data is obvious: One cannot use analytical tools unless the observables fit the tools. So, it was a bit of a shock to find that the idea was not held automatically as a given by every scientist. On the other hand, the question was so sincere that I had to take it seriously. On the third hand (It is interesting how many hands one can go through in a split second. I was the only male in the room filled with women. Their presence created a quiet atmosphere of information exchange that I have not encountered in male-dominated surroundings), in the brief moment between hearing the response and uttering something of an answer, the course of my own research life flashed through my mind.

Let me summarize what came to mind. The new students of dynamical systems thinking are using the borrowed terminology *metaphorically.* Real-life systems are complex and unpredictable. Old rule-based thinking that has been used to achieve solutions to complex problems, such as long-term planning to reach a particular goal in business or to manage natural resources have failed miserably. The possibility that something simple, like the logistic equation, can be unpredictable, that chaos can emerge in a simple system, that sudden changes may occur through bifurcation dynamics, and that behavior is naturally complex are immensely important realizations. Perhaps most importantly, the terminology such as "sensitivity to initial conditions" fits well because that is what we observe daily. "The best laid plans of mice and man ..." are seldom achieved. Such realizations are reassuring because they relieve one of the responsibility to come up with "sure-fire" solutions to complex problems. I am not sure, however, how well people realize that the connection between chaos theory (if there is such a thing) and real-life problems is presently only metaphorical.The creative stage in the analysis of difficult problems is open-ended. Anything is and should be possible. The shift into something more scientifically substantive is quite difficult, but necessary.

To illustrate the point, I shall briefly summarize two research instances, my own and Isaac Newton's (...Well, if you're going to drop names, why piddle around with small ones?). Being a behavioral neurobiologist, with a background in psychology and learning, my experience may be similar to that of many people in the Society. So, let me briefly describe it in order to give my impression of the utility of chaos.

By the mid to late '70s, I had **(CONTINUED ON P.3)**

BOOK REVIEW: L. Douglas Kiel, Managing Chaos and Complexity in Government: A New Paradigm for Managing Change, Innovation, and Organizational Renewal (San Francisco: Jossey-Bass, 1994, 246 pp. $24.95)

Reviewed by Philip S. Kronenberg, Ph.D., Professor of Public Policy, Virginia Polytechnic Institute and State University, 2990 Telestar Court, Falls Church, VA 22042 PHILK@vtvm1.cc.vt.edu

Movements to improve the performance of the public sector by transforming the organizations of public administration for many years have washed across our institutions and the commentary of both popular and academic observers. Much of this litany of improvement has focused on linear optimization and efforts better to rationalize means-ends relationships: Performance budgeting in the 1940s, PPBS in the 1950s and 60s, zero-based budgeting and strategic planning in the 1970s, and continuing with the current fascination with Total Quality Management, Business Process Reengineering and "Reinvention." Beginning in the mid-80s, there were efforts to apply insights from the emergent research into chaos and complexity theories to the study of government and public agencies. The new book by L. Douglas Kiel, associate professor of government at the University of Texas at Dallas, seeks to contribute to that growing arena of inquiry.

Kiel views his purpose as promoting a new paradigm for managing public sector organizations based on chaos theory and research on nonlinear dynamical systems. His target audience consists of practicing public managers and academics engaged in the study of public administration. Given my personal experience **(CONTINUED ON P. 11)**

Newton's Heifer (CONTINUED)

realized that the way we were trying to understand neurointegration and how learning may fit in it would not work, for the same reasons noted above, of variability, complexity, and unpredictability (for a review see Mpitsos & Soinila, 1993). Behaviors and the underlying neural patterns seem to blend into one another, neurons share functions, and the output of the nervous system can in some cases compensate for the loss of even ones having strong effects. A set of neurons may be capable of producing many different behaviors, possibly even without any neuromodulation or synaptic changes. But it was a time, as it is now in many circles, of the single-synapse explanation of learning. It was thought that having knowledge of how neurons are interconnected and of the strengths of their connection was insufficient to know how behaviors are produced. In fact, it was obvious to everyone that the circuit could not really be defined, though it is interesting how many people seemed easily to pass by this point. It is also interesting to see how the idea still persists. One computer scientist, with a background in neuroscience, at a large eastern university instructed me that to simulate and understand how a sea slug brain works all one needs to do is "to all make all the measurements that define the state of the system." It cannot be done. We do not even have a language with which to handle simple problems in such systems. What I did have in mind were images of "reverberating" dynamics, to use a word I picked up from D. O. Hebb somewhere. I did not know of attractors, of driven oscillators, the Duffing and Van der Pol systems, of the Rossler, of the chaotic logistic equation, of bifurcations, of chaos. It was a bit early for that, but as I later found out, the ideas were out there.

I realized, that the images I had in my head were metaphors and that I needed to restate them in mechanistic terms. In seeking the source of the observed neural and behavioral variations, I discovered dynamical systems studies, and, like many of you, I felt a sense of "coming home." The problem was to place the data within the framework of the available tools. More accurately, the sea slug was giving me answers, and the problem was to determine whether the methods could be applied in order to understand the answers.

The first publications dealt with the idea of attractors and parallel processing conceptually (Mpitsos & Cohan, 1986a; Mpitsos & Cohan, 1986b). On that level things seemed to fit, with the difficult kicker that adaptive behavior was not centrally programmed, but that it seemed to emerge dialectically between the animal and the environment. That is a problem because if neural integration emerges from the interaction between two mutually defining poles, there is little chance of controlling either one sufficiently to obtain repeatable results. Chaos seemed a natural way to account for the variation. However, from the beginning the tools did not seem to fit the data, as stated in the papers themselves (Mpitsos, et al., 1988a; Mpitsos, et al., 1988b), and in commentaries (Mpitsos, 1989). We developed a "Chaos Users Toolkit", still available by anonymous ftp in a public directory on the computer "slugo" at my e-mail address. You may also obtain it directly from a journal which devoted an entire issue (Integrative Physiological & Behavioral Science Vol 29 (3), 1994) to commentaries and software for dynamical systems studies of experimental findings. We have not had the funds to keep the Toolkit properly up to date, but it is still useful, as one can do two-dimensional Poincar$ sections and 1-D return maps, dimensional analysis and Lyapunov exponents, and play a bit with model systems. It contains the Grassberger-Procaccia algorithm for calculating attractor and embedding dimensions, though the important surrogate methods have not been programmed yet. Applications of some of the new tools indicates that there are few neural systems that meet the criteria required for demonstrating chaos, low dimensional embedding space, or even for determinism (Glass & Kaplan, 1993; Schiff, et al., 1994).

Personally, I am not so interested in defining some number, as I am in using the concepts to give me an idea of potentially testable conditions to examine in biological experimentation that might not have been anticipated from traditional biological approaches. Walter Freeman and coworkers (Skarda & Freeman, 1987) were perhaps the first to take this approach, and much to his credit, he resisted as long as possible in making numerical estimates of "fractal" dimensions. In a sense, one assumes the existence of some phenomenon, such as a chaotic attractor, and then determines whether this leads to useful results. Other researchers have used this approach in ways that may be applicable clinically (Garfinkel, et al., 1992; Schiff, 1994; Weiss, et al., 1994). Our own application of this approach has suggested ways to unravel a rationale underlying the functional organization of complex neural structure (Burton & Mpitsos, 1992; Mpitsos, 1995;**(CONTINUED ON P. 8)**

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CONFERENCE DISCOUNT or HAVE YOU PAID YOUR $25 MEMBERSHIP FEE?

IF NOT, PLEASE SEND IT TO ADDRESS AT TOP OF PAGE ONE. THOSE WHO ARE PAID UP AT LEAST ONE MONTH PRIOR TO THE ANNUAL CONFERENCE WILL RECEIVE A DISCOUNT ON THE CONFERENCE REGISTRATION FEE.

FIFTH ANNUAL INTERNATIONAL CONFERENCE--THE SOCIETY FOR CHAOS THEORY IN PSYCHOLOGY AND THE LIFE SCIENCES
AUGUST 8-12, 1995
Adelphi University, Garden City, New York

As in past years, this year's conference exhibits a diversity of research in various psychological fields as well as economics, political science, anthropology, sociology, philosophy, education, nursing, business, art, and mathematics. Also, in keeping with past practice, this conference will precede the APA Annual Conference in New York City. The Fifth Annual International Conference of the Society will take place on the campus of Adelphi University located in the Long Island suburbs of New York City, near a commuter railroad only 30 minutes from Manhattan. JFK Airport is 20 minutes away by car, and La Guardia Airport is only 30 minutes by car. Adelphi will be providing very inexpensive room and board.

COSTS:

Conference Registration Fee: $110.00 for members; $145.00 for nonmembers; $65.00 for students. (Full Membership is $25.00 per year; $10.00 for students). Some scholarships will be available for students in exchange for working in the registration booth and other tasks during the conference.

Room and Board: $25.00 per person per night---Single Occupancy; $21.00 per person per night---Double Occupancy

Meals: $50.00 for three meals per day for three days. Please note that there will be a banquet on the second night of the conference, the fee for which is included in the registration fee.

Workshops: $ 110.00 for full-day workshops; additional $25.00 for workshop with Fred Abraham for computer use; $75.00 for students.

Make checks payable to The Society for Chaos Theory in Psychology and the Life Sciences and send to Jeffrey Goldstein, address on the newsletter. Unfortunately we can only accept checks drawn on US banks since it costs us $25.00 for each foreign bank deposit that we are able to deposit and we are unable to deposit checks from many foreign banks at all. Also, we do not accept credit card payments--see page 3 of this newsletter for information about international payments.

PROGRAM (as of 5/18/95--additions forthcoming)

KEYNOTE AND BANQUET SPEAKERS:

Ary Goldberger, MD Harvard Medical School: Chaos versus Fractal Scaling

H. Bruce Stewart, Ph.D. Brookhaven Nat'l Labs: Classifying Chaotic Attractors

PRESENTATIONS AND SYMPOSIA:

From Gestalt to Gibson: Aspects of dynamical theory in holistic traditions in early-mid 20th Century Psychology --F. Abraham, Waterbury, VT

Dynamic Patterns of mood disorders: Chaos and Randomness in mood and motor activity-- L. Gaber & R. Gutman

Modelling the dynamics of psychological phenomena: An autonomous agents approac-- C. Scheier, Univ. of Zurich

Order and complexity in psychotherapy: An Empirical Approach-- W. Tschacher & C. Scheier, Social Psychiatric Research Hospital, Zurich

Dynamical aspects of applications of chaos theory with individuals, families and organizations--R. Weinberg, National-Louis University, Symposium Chair; With: B. Hudgens, NLU; R. Clark, NLU

Stages of change as a dynamical system S. Clair, University of Houston

Panel Discussion: Nonlinear Dynamics and Psychotherapy:A Meeting of Different Schools-- Family Therapy: L. Chamberlain, Colorado Family Center Strategic/Systemic: R. Hawkins, Austin Regional Clinic; Psychoanalytic: A. Stein, Psychoanalyst and Independent Scholar;Jungian: J. Hollwitz, Creighton University

Can nonlinear forecasting cope with noisy data?-- L. Ward & R. West, University of British Columbia

Studies of Mental "Noise"--K. Clayton & B. Frey, Vanderbilt University

Requiem for the Ego--A. Stein, NY

Trail-blazing in the labyrinth of intelligence: The structure, construction, and interpretation of path-following tests-- D. Vickers, University of Adelaide.

Myth as strange attractor: Levi-Strauss and chaos theory-- L. Sundararajan, Rochester, NY

Self-Organized Criticality and Competitive Behavior between US States-- S. Andermann, Southern Connecticut State University

Punctuated Equilibrium and Incrementalism: Together again for the first time-- S. Andermann, Southern Connecticut State University

Cellular automata modeling of TQM implementation-- K. Dooley, University of Minnesota

Walrasian general equilibrium and nonlinear dynamics-- M. Dore, Brock University

Complexity and chaos: Applicability to organization science-- E. Garcia, Stern School of Business, NYU

Hysteresis, bifurcation structure, and search for the natural rate of unemployment-- S. Guastello, Marquette University

Models of power: Chaos theory in social science research-- S. Hagberg, SUNY-Buffalo

Beyond the metaphorical: Resources for teaching nonlinear analysis-- P. Hamilton, Texas Women's University, Symposium Chair With: J. Pollack, TWU; D. Mitchell, TWU,T. Pensabene, TWU

Self-organizing systems in the classroom-- J. Hays & S. Wolff, Boston University, School of Management

Chaos, paradox and learning: Towards a more holistic strategic paradigm for business-- J. McKenzie, Henley Management College, United Kingdom

Chaos theory: An education-based case study-- H. McWhinnie, University of Maryland

The celebration of uncertainty: A study of the dynamics of equanamity-- F. Mosca, Thornwood, NY

Toward a formal theory of collective intelligence-- W. Sulis, McMaster University

Iconography of Chaos in a Renaissance Painting-- T. Zausner, New School for Social Research

Chaos theory and Business performance measurement-- S. Ashley & S. Robinson

PRE-CONFERENCE WORKSHOPS: Tuesday, August 8; 9AM-4:30 PM

(more extensive bios of the workshop instructors were included in the last newsletter and inserts)

1. *DYNAMICAL CONCEPTS IN PSYCHOLOGY.* Fred Abraham, Ph.D., This will be a fairly introductory workshop focussing on basic concepts of dynamics and their application to psychological theory and research. It is felt that these basic concepts are central not only to using dynamics, but to moving on to other related topics in comlexity analysis, some of which will be mentioned albeit rather briefly. Hands-on computer experience will be utilized to explore simple properties of dynamics, attractor types, separatrices and basins, dimension, spectra, etc., for known low-dimensional atractors such as the prey-predator, van der Pol, logistic, Henon, Rossler, Lorenz, etc; and for empirical data sets. The emphasis will be on understanding the basic principles of attractors, bifurcations, and stability. Fluency in math is not required--it is intended as an introduction.

2. *CHAOS AND CREATIVITY.* Stephen Guastello, Ph.D., This workshop explores the role of nonlinear dynamics and self-organization in the creative process, including scientific, artistic, business, and other domains. Program features exercises for enhancing creativity in individuals, groups, and organizations which capitalize on chaotic or dynamic processes. Exercises are organized in a graduated series from elementary skills to complex problem solving. Participants are encouraged to bring problems that they would like to work on, such as chaos modeling for a research project, methods for enhancing creativity in a group with which they work reguarly, or some other problem requiring creative input. Updates on the latest research developments are also included.

3. *AWAKENING 101.* Sally J. Goerner, Ph.D., Chaos and Complexity are best understood as new insights into the way interdependence produces pattern, structure, and organization. If one understands them this way, it become obvious that they are but a small part of a vast cultural shift emerging in human endeavors from education to government, in academic fields from biology to economics and which connects with a vast array of long-standing spiritual and philosophic traditions. The implication is that western civilization is undergoing a comprehensive transformation exactly like one that happened 300 years ago. That change produced the *Enlightenment,* materialist mechanistic science, and the clockwork sense of the universe. The current change is producing science centered on interdependence, a detailed understanding of the world as an intricate interdependent web and an *Awakening* from what seems to have been a long dogmatic mechanistic slumber. This course provides a concrete, common sense tour of the science, sociology, economics and spirituality of the post-clockwork universe. We will discuss why clockwork thinking will end and how Chaos/Complexity clarifes the change.

POST-CONFERENCE WORKSHOPS; Saturday, August 12; 9AM-4:30 PM

4. *INTRODUCTION TO COLLECTIVE INTELLIGENCE.* William Sulis, MD, Ph.D.,, The study of collective intelligence has been a major facet of entomological research for many years and has been embraced by the artificial life community as a promising alternative to both conventional and connectionist approaches to the understanding and generation of intelligent behaviour. This workshop provides an introductory survey of the empirical evidence upon which the concept is founded and some of the experimental and theoretical approaches being currently undertaken in order to study it. Part 1: Empirical Background: Collective organisms- slime molds, collective intelligences- social insects: ants, wasps, bees. Stigmergy, decentralized control. Collective behaviour- swarms, mobs, crowds, societies, economies. Part 2: Experimental and Theoretical Approaches: Collective robotics, behaviour-based robotics, cellular automata, statistical mechanical theories of swarms, the pattern landscapes

5. CLINICAL CHAOS: What Psychotherapists Need to Know About Chaos Theory; Linda Chamberlain, Psy.D., & Ray Hawkins, Ph.D., The workshop will focus on the basic concepts and paradigms in chaos theory and the implications of those ideas for clinical practice. Emphasis will be on how to conceptualize problems and solutions from a non-linear perspective. Presentation of several case studies will help to link theory to practical applications in therapy.

6. APPLYING CHAOS/COMPLEXITY THEORY IN SOCIAL SYSTEM INTERVENTIONS: Mark Michaels, Key models of human behavior are always drawn from contemporary developments in the physical science. Kurt Lewin's pioneering model of social psychology, developed in the 1940s, is no different. For the past seven years, an international group of social theorists, interacting through The Chaos Network, have been developing new models of social intervention based on the emerging science of chaos and complexity. This workshop shares the application of the new sciences as developed by Network members.

7. WORKSHOP IN THE NONLINEAR DYNAMICS OF FREEDOM: Frank Mosca, The workshop will make an historical review of varying attitudes toward freedom down through the ages and then will offer a practical intensive method of breaking out of the apriorized certainties imposed by myth, tradition and culture and gain what I call final "volitional escape velocity" to exit the basins created by human history and ideologies. Naturally, that does not mean that you don't attend to the social and political covenants that obtain or that you do not creatively engage the practical exigencies of time place and circumstance. But rather, that you do so out of an attitude of Awe-in-Freedom rather than a dread-driven-determinism.

REGISTRATION FORMS FOR CONFERENCE AND WORKSHOPS:

(send to Jeffrey Goldstein, Ph.D., address of newsletter)

CONFERENCE:

Name:_____

Address:_____

_____

Phone:_____ Fax: _____ Email:_____

University Affiliation (if any):_____

Presentation Title (if submitted to Steve Guastello):_____

Type of Room and Number of Nights in Room _____

Number of Days for Meals (3 days for $50.00; $17.00 per additional day)_____

WORKSHOPS:

Workshop Title:_____

Workshop Title:_____

Name: _____

Address:_____

_____

Phone:_____ Fax:_____ Email:_____

University Affiliation (if any): _____

Chaos, Initiation (CONTINUED)

Initiation has been the method of personality transformation in the ancient world, in living esoteric systems, and in non-industrial societies. The mystery religions of the Graeco-Roman culture and the ancient Middle East contained at their core, a ritual repetition of the death and resurrection of a god. As part of the mysteries of Isis and Osiris and in the rites of Demeter and her daughter Persephone, the initiate would first re-enact the mythic journey of a deity to the underworld and then the return of the deity transformed. (Meyer, 1987, Eliade, 1978) In esoteric living doctrines such as the Kaballah, substance is believed to be formed out of chaos. To transform the self, the initiate repeats the process of creation beginning in Tohu, the Universe of Chaos. Only afterwards can the initiate enter YHVH, the Universe of Rectification, where reintegration occurs. (Kaplan, 1990) In non-industrial societies, such as that of the Australian aborigines, initiation is the mark of maturation. It signifies the death of childhood and the beginning of life as an adult member of the tribe. A state of disequilibrium is produced in the initiates through ordeals of fear, hardships, and darkness. (Eliade, 1958)

Through the process of initiation, a person is led back from chaos to the conscious world of daily life. Far-from-equilibrium conditions are a method of transformation not an end state. To be stuck in chaos or caught in the underworld can be seen in certain aspects of mental illness, such as the continuing confusion of dementia and schizophrenia. (DSM-III-R, 1987)

In the contemporary industrialized world, aspects of initiation are paralleled in the process of psychotherapy. As the initiate contacts the underworld through precepts of religion, the analysand contacts the unconscious through guidelines of psychology. In an effective course of psychotherapy, periods of stress through which unconscious contents are integrated into conscious awareness are like the transformative stress of an initiation. Like the initiate, the analysand has a guide, the therapist, and also like the initiate, the analysand contacts the unconscious in a conscious manner. The analysand goes into the unconscious but does not go unconscious. The intermittency or islands of order within chaos (Gleick, 1987) may correspond to the continuing consciousness of the individual and act as the foundation from which the new personality bifurcates. Examining the unconscious in an effort towards self-transformation is very different from going unconscious as a form of stress release such as found in addictions.**(CONTINUED ON PAGE 15)**

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is useful and informative, there remains an entirely new and unexplored perspective arising from the lack of a realistic assumption about the true distribution of leadership potential within a group, organization, or society.

Psychological measurements are almost universally founded on, or engineered to assume, a normal Gaussian distribution, and leadership research is no exception. West (1994) reported that numerous variables of psychological importance appear to be exponentially distributed, which would be symptomatic of an underlying nonlinear dynamical process. Creative behavior is a notable example, and concerted attention has been given to its dynamical properties (Guastello, 1994a, 1994b, in press). The objective of this current study was to illustrate the non-normal distribution of leadership in an emergent group situation, and to identify a probability density function that does in fact characterize real situations. A clash between normal distribution concepts and reality occurs when we view societal structures where the leaders emerge, as a result of a society dynamic, rather than appear through appointment by a higher authority. The ratio of actual leaders to total constituency is low. For example, in the U. S. Federal Government there are less than 600 elected congresspersons, senators, or presidents combined at any one time for a nation of approximately 250 million. In the last 100 years of U.S. Presidency, barely ten were occupied by an elected vice-president (as the result of an untimely death of a president), and only 3 years of one presidential term were occupied by a third in the command chain.

The other side of the "leadership is rare" thesis is the argument that leadership is more widely distributed in the population than appearances would indicate. A large and complex social structure creates important roles for less prominent, or more specialized group members, who thus accede to more circumscribed situations in which to express leadership. Group members are thus thought to define their roles and express leadership tendencies in more specific ways (Cattell & Stice, 1954). In an emergent leadership situation, the group begins with a task and no designated leader. A leader eventually emerges, and other group members formulate more specific roles for themselves. This process appears to be a case of self-organization at work.

In spite of the 40 years that have elapsed since Cattell and Stice suggested the multiple leadership role dynamic, there has been little systematic attempt to test their hypothesis directly. If Cattell and Stice were essentially correct, a frequency distribution of leadership behavior should show a mode at the near-zero level of leadership, a minor mode located at high levels of leadership, and at least one other mode between the other two signifying secondary leadership contributions. The extent to which leadership is widely distributed would be indicated by the relative density of the near-zero mode compared to the others.

Exponential Leadership

Simonton (1988) and Lotka (1926) introduced the possibility of logarithmic probability functions with respect to creativity, but Simonton also argued that creativity was a form of leadership. I later discovered (citations above) that the distribution of creative behavior was not exactly exponential either, but irregular and conforming to a mushroom (parabolic umbilic) catastrophe probability density functions (pdf). The distribution shows the now-characteristic pattern of blast (high density), cascade, plateau, antimode, and aftershock. The mushroom catastrophe is the result of a complex dynamic involving two interacting outcome (or order) parameters and four control parameters.

The catastrophe models can be expressed in statistical form as a set of multimodal exponential families of statistical distributions (Cobb, 1981; **(CONTINUED ON PAGE 13)**

Newton's Heifer (CONTINUED)

Mpitsos & Burton, 1992). The upshot of such studies, for the present discussion, is to illustrate the utility in making the shift from creative metaphor to some tangible mechanistic phenomenon that can be analyzed by oneself and corroborated by other researchers.

It is, in fact, remarkable how a simple shift in terminology may open up vast research or philosophical frontiers. Thomas Kuhn points this out in his shift of phrases from "normal science" to "puzzle solving" and from "consensus" to "paradigm." The experimental scientist must place such newly devised or adopted concepts into practical productive tools. But it is one thing to play with metaphors, and another to use them to advise people in matters that may have far reaching and potentially unexpected consequences.

Newton provides the best example of one who took an idea and transformed it into something that changed the course not only of science but of history itself. What I have to say here about Newton is partly speculation on my part, for I have not had the time to chase out all of the details, but it will serve to make the point of this paper. Like all of us, Newton was a product of his culture, and, I believe, he took his seminal insight from it. The early Seventeenth Century, just before Newton, was witness to undercurrents of philosophical, mystical, and religious tensions. Paradoxically, Gnostic Christian liaisons between intellectuals, mystics and occultists in the continent and England (Yates, 1972; Yates, 1979) set the stage for the decline in the influence of the church, and for the shift into mechanistic science. This is paradoxical for two reasons. First, because it was the church that had subdued and nearly exterminated Gnostic philosophy over the preceding fifteen hundred years. Second, it was not the intent of this movement to have the unfortunate effect that it did on the church, but to create a vehicle with which to inject a soul into a powerful technological science that the movement anticipated. The vehicle was the formation of the Royal Society of London (Yates, 1972).

The person responsible for the demise was Newton. As Magellan (Manchester, 1992) provided the first of two devastating blows to the church, Newton supplied the second. The seminal philosophy that ignited Newton's work came from a German shoemaker, Jacob Boehme (1575-1624), perhaps the greatest of the Christian mystics. Newton knew people who were Gnostics or was himself a Gnostic, and he undoubtedly knew of Boehme's writing. Whether he responded consciously or subliminally to it is of interest academically but is inconsequential to the final result. The cleric, William Law ((1986-1761), p. 375) provides some insight into the possibility of the connection. He was, I believe, an admirer of Newton's work, but, given his mystic bent, it is not surprising to see a bit of derision in assigning credit to the source of Newton's insight when he says that,"...*the illustrious Sir Isaac plowed with Behmen's [Boehme's] heifer when he brought forth the discovery of' his three laws.*" The specific way by which Boehme influenced Newton must surely have already been outlined by historians, for when slogging through Boehme (his writing is intentionally obtuse to discourage casual readers!), the way that he did seems obvious. Boehme introduced a new and radical form of dialectic philosophy by which all elements of the universe, even of fundamental divine function, are defined by resistance between them and their opposites (see Berdyaev's introductory essay in (Boehme,1575-1624)).

Boehme accepts no static divine absolute, but rather sees the divine and the manifestation of everything as a continual dynamic tension or resistance of one thing against its opposite. One thing defines itself with respect to another, and it is not possible to consider either independently of the other. My own summary of Boehme's writing, before I happened to run across Law's reference to Newton, was in the phrase: for every action there is a reaction. Sound familiar? It is Newton's third law. If this is so, Newton's genius was not in hatching his laws of physics de novo, but in taking a metaphor out of the context of his culture and placing it in mechanistic terms that can be used to construct, predict, and control systems. Through Newton, culture laid a golden egg, and in the intervening 350 years or so it has used it to incubate the next. Like Richard Dawkins' The Selfish Gene, human culture has set out on a fascinating evolution over long time scales to discover itself. As part of this culture, the understanding of the dynamics in social systems, or in any adaptive system, is the task that faces us now, but it is a task for which we may not have the necessary metaphors with which to start. The fact that we can not predict events in the future does not necessarily mean that we are dealing with the initial conditions of chaos. The fact that we are faced with complex systems does not necessarily mean that we are dealing with the complexity generated by low-dimensional chaos. And, interestingly, the fact that we might be dealing with completely deterministic interactions at the local level, does not necessarily mean that the information flow at these local levels is free of degeneracies (more on this at some later time). Given these extended "nots", it is complex biological systems that will force the development of new metaphors and new tools with which we might understand the culture in which we live.

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(CONTINUED ON PAGE 11)

CHAOS THEORY IN PSYCHOLOGY AND THE LIFE SCIENCES

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Book Review (CONTINUED)

in both categories, I read the book with some relish. By and large, I was not disappointed, although several elements of Kiel's book illuminate the immature state of our efforts to move from the ontological and epistemological grounding of chaos and complexity ideas in mathematics and the physical sciences to the exquisite complexity of large-scale human social systems in the operational world of public policy.

The book opens with Kiel's advocacy for a new public management paradigm based on nonlinear dynamics. He then proceeds in subsequent chapters to: describe the character of change dynamics in public agencies and how change generates instability; demonstrates the use of a method he calls "activity-based costing" to gather time series data to picture the rhythms of the workplace; apply these data on a phase plane to see attractors and the underlying deep structure of workplace dynamics; and then argues--through the last half of the book--for the need by public managers to liberate themselves and their agencies from the stultifying grip of linear, control-oriented thinking so as to exploit the beneficial fluctuations that are natural to nonlinear dynamic systems and, thereby, generate the transformational possibilities that come from the self-organizing energies of people and organizations that are freed from the heavy hand of Newtonian management. The final chapter consists of 24 lessons that Kiel offers to public managers derived from his analysis in the book, followed by an appendix that describe the so-called Activity-based Costing method that Kiel used to collect the time-activity-cost data on public workers in an Oklahoma state finance agency that he used to illustrate some of the concepts in his book.

The Kiel argument can be summarized as follows: Traditional views of public management are based on linear thinking that assumes it is possible to manage change internal and external to organizations because change is relatively gradual and that the control mechanisms of bureaucratic structural arrangements can provide correct responses with predictable results in order to do the public's business. But, for Kiel, linear structures of control do not work because they cannot accommodate the dynamic contexts in which public organizations must act. His critique of traditional public management goes beyond the theme that linear structures are inefficient and ineffective instruments for dealing with nonlinear circumstances: They also, he argues, restrict the freedom of organizational employees and prevent them from liberating their creative talents that would otherwise be available if the paradigm of nonlinear dynamics guided the processes of the public workplace. Kiel promotes the enthusiastic embrace of a process focus by public managers who would embrace the risks needed to transform public agencies everywhere into freewheeling exploiters of the untapped potential of uncertainty embedded in nonlinear dynamic systems.

One thing struck me after thinking about the book's argument: In some ways it is old wine in new bottles. The notion that machine-like bureaucratic organizations inhibit freedom of action of talented workers and undermine the responsiveness to uncertainty of large organizations is a very venerable theme. It was a theme that is rooted in all of modern sociology and contemporary organization theory going to the early 1940s (and grounded in the important ideas launched in the 1890s by Max Weber's hugely important contributions to political sociology--unfortunately disregarded in Kiel's dismissive treatment of Weber) as well as in Aristotle's contributions to political philosophy (and the theory of the centralized state rooted in Imperial Rome). But the old vintage of this argument should not deter us from seeking the value-added that I believe to be in the Kiel book: It is a broad-gauged effort to apply ideas from chaos and nonlinear dynamics to the field of public management and to do so in a way that demonstrates some key ideas in this new setting as well as some tools of empirical measurement.

Although there are some areas in the execution of the book that I wish were stronger, Kiel has taken on a very ambitious agenda and should get good marks for a competent undertaking. Let me illustrate several examples of this value-added quality of the book. First, he contributes to efforts to use chaos-related ideas in attempting to think about the often baffling uncertainty of public affairs as phenomena that have a patterned quality however obscure such patterns may be at times. He draws on chaos theory, in other words, to suggest that there are aspects of this uncertainty that are something other than randomness and caprice. (His treatment along this line might have helped us more if he had pointed more explicitly to a way to partition in our thinking the processes of public affairs into sectors that are ordered in nonlinear dynamics in contrast to those that are random--and thus quite capricious in the program or policy terms that he discusses. Much of the practical concern with "chaos" among practitioners of public management and politics is about randomness--not nonlinear order). Second, he provides graphical illustrations of chaotic behavior at a very concrete **(CONTINUED ON P. 12)**

Book Review (CONTINUED)

level of measurement. This gives the reader a sense of the operational meaning of certain concepts and tools useful to grasping nonlinear dynamics (e.g., butterfly effect, phase plane, attractor). Third, he provides opportunities to test some of these ideas in a very hands-on fashion using spreadsheet software; this adds to the reader's sense that the abstractions of chaos theory can be grounded in analytical experiences that can be generated on the reader's personal computer. Finally, part of the contribution of the book comes from issues it raises for students and practitioners of public policy who must confront the reality that any book that attempts to apply chaos and complexity ideas to social systems to a certain extent is limited by a field of scholarship that is an immature work in progress

Let me illustrate this point by suggesting several places where the Kiel book (and perhaps our common enterprise of scholarship) needs strengthening. First, the author's advocacy of nonlinear dynamics as the new paradigm with which to understand all complex systems and to transform public administration and its management gives us little sense of the ontological and epistemological bases which differentiate the virtues of a nonlinear dynamic paradigm and the vices of linear, Weberian, Newtonian thought. He asserts rather than demonstrates in his argument that the total underlying character of social reality is nonlinear dynamics. For example, the discussion in Chapter 2 points to a form of stability or equilibrium that is possible in a dynamic system that can produce a Weberian ideal of organizational stability. Yet he is fundamentally critical of Weber's views on the rational design of governmental organization in modern societies, which he feels locks one into a machine-like pattern that doesn't fit reality. Either Kiel's notion of stability is somewhat misplaced or he has not linked it sufficiently to the rich meaning of equilibrium in Weber's theory.

Second, the discussion throughout the book regarding data about the workplace and the author's emphasis on measures of organizational performance seem to minimize the role that political and social forces play in setting goals and making the choices about "keeping score" in evaluating public policies. Indeed, as one reads the book one would almost forget that the determination of performance criteria are not given in nature (as they are sometimes portrayed--incorrectly I think--in the physical and life sciences) but are the product of conflictive personal and group choices about what is important, and to whom! This point applies not only to efforts by managers and oversight authorities to set goals and hold agencies and employees accountable for action but also applies to those who try to build models to explain and predict the outcomes of individual and collective action.

Third, the author's laudable concern for recognizing the need for change in rigid work environments and the presence of nonlinear processes in politics and public policy seems to get out of control at times in his celebration of the liberating effects of nonlinear dynamics. Discovery of nonlinearity doesn't necessarily make the case that all is nonlinear or that efforts to control nonlinear processes are without virtue. Yet that is clearly the thrust of the entire book. There is sense of "Let's everybody do his/her thing" in Kiel's embrace of a kind of optimistic anti-linearity in the new paradigm that he champions.

Fourth, one has to but wonder what role is retained in his approach for ideas about the nature of the public interest and political democracy. The principal value-set promoted by the book seems to be "change for its own sake." And there is little consideration given by Kiel for efforts by the elected representatives of the people to control bureaucratic impulses in enforcing the priorities of public policy set forth by democratic institutions. This raises issues about both the proper design of institutional processes that would characterize the relationships between political representatives and public agencies as well as the normative issues that swirl around the effort--quite venerable in political philosophy--to raise the question: "Who are the guardians and who protects us from the guardians?" What are we now to make--given the Kiel book--of the Newtonian mechanics built into the process arrangements crafted by Jefferson, Madison, and others in the U.S. Constitution?

My conclusion? This is a useful book that is well worth buying and reading. I think the book is much more successful in getting us to understand better the nature of organizational dynamics and change processes than it is as a prescriptive basis for designing and managing public agencies in a democratic society. While I have some reservations about his argument and analysis, the author has brought an important set of concerns to bear on our conversations about the relevance of chaos and complexity theories for the management of public affairs.

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Leadership (CONTINUED)

Guastello in press). Each of the elementary deterministic catastrophe models is embedded in the topology of the next most complicated model. Because specific pdfs are associated with specific models, a similar relationship holds among the catastrophe pdfs.

The mushroom pattern also appears to be evident in the theoretical distribution for Kauffman's (1993 p. 130, 136) N/K distribution, which shows several local maxima and minima. For a species that is subject to an environmental stimulus or assault involving K attributes of the species, N is the number of species members who will survive through successful adaptation. The statistical modes represent types of species or subspecies that would be expected to emerge given exposure to the environmental assault. Some would be more plentiful than others.

The similarity between the frequency distributions that one might obtain for two different outcomes, e.g., species survival and leadership, does not by itself prove that the two phenomena are the result of entirely the same process. The similarity between two distributions can be an important signpost that the two processes share similar dynamics. The signpost looms a bit larger if the distributions in question are known to be associated with the more exotic and specific nonlinear dynamical processes.

The key arguments for exponential creativity distributions can be rephrased in terms of emergent (rather than appointed) leadership. Let N be the number of trait or situational predictors of whether a leader was politically or organizationally viable. Let predictors of leadership potential be normally distributed and correlated with votes. The distribution of N over candidates would not be normal, but distributed as e^N.

In experimental group situation that follows, for each group of 8 people, we allow one leader with one second-in-command, and let the group members rate each other with regard to who exhibited the most, then second most leadership behavior in the group after an hour's work. The central hypothesis is that the distribution of leadership ratings would exhibit an exponential quality. Thus, most members would have no votes, but only one could have the maximum value. The second hypothesis is that the distribution of leadership ratings would deviate significantly from a common exponential distribution, and would display local minima and maxima. The local modes would be predicted from Cattell and Stice's (1954) general principle of a major leader and more specific leadership roles.

Method

Participants were 94 adults who participated in a group problem solving exercise that was conducive to the emergence of a leader from an initially leaderless situation. The sample included 60 undergraduate and graduate students in introductory and industrial psychology courses, and 34 campus security officers. Participants ranged in age from 20 to 55 years. The racial distribution was: 84% White, 7% Asian, 6% Black, 2% Hispanic, 1% Native American. Players were organized into games of 8 players with a range from 7 to 9 players.

The exercise was a game called Island Commission (Gillan, 1989). In the game, players took on roles of civic leaders on a small island which was located near a "friendly power." The group was presented with a budget that they needed to allocate to several interrelated, and sometimes conflicting, internal development projects. The game usually plays for an hour plus instructions and debriefing. At periodic intervals, an information bulletin was presented to the players which contained news that would affect and often scramble any tentative plans the group was in the process of making. Thus the need for creative problem solving arose as players developed ideas for redistributing budget and other resources, responding to social emergencies, and at the same time observing the restrictions associated with the budget allocation.

At the end of the game, the participants completed a simple questionnaire containing the following item: *A list of role names for the Island Commission players appears below. Which person demonstrated the most leader-like behavior, in your opinion? Mark a "1" in the space to the left of the name of the person who acted most like the leader of the group. Mark a "2" in the space to the left of the name of the person who acted second most like the leader of the group. You only need to mark the top two people.* After the ratings were collected the rankings or votes from each participant for each participant were tallied within each group. A ranking of "1" was coded as 2 points, a ranking of "2" was coded as 1 point, and 0 points were allocated otherwise. The score for each participant that was used in the analysis was the sum of points collected from all participants including themselves.

Results

Figure 1. Frequency distribution of leadership ratings showing swallowtail configuration. Intervals calibrations represent the lower limit of the interval.

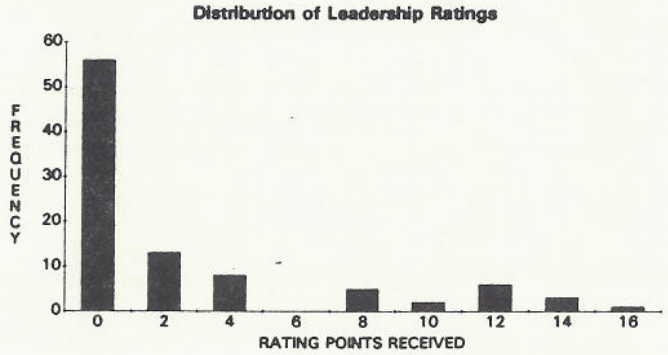

Figure 1 shows the distribution of leadership ratings received by individuals from fellow players. The distribution was clearly not a normal **(CONTINUED ON P. 14)**

Leadership (CONTINUED)

distribution. The Komolgorov-Smirnov test was used to determine whether the function deviated from a common exponential function with a mean of 2.83. The test was significant at $p < .05$. A significant Kolmogorov-Smirnov test requires only that one interval of the frequency distribution deviate from its expected value by a critical amount. In this case, four intervals exceeded the critical absolute value. It was useful, therefore, to determine which intervals they were for purposes of developing a further interpretation of the observed frequency distribution. The 0 interval did not exceed the expected value, but significant deviations were observed for intervals 1, 2, and 3. Thus, the observed densities were less than values that would be expected for values of 1, 2, and 3 under a common exponential hypothesis; the differences in density were pushed to higher values of y (the rating score). The fourth significant difference was obtained for the interval at $y = 7$, which was caused by the observed antimode, where nonzero density would have been expected.

The conclusion is that the apparently exponential distribution for leadership is actually something more complicated; it matched none of the variants of the commonly known statistical distributions cataloged in Evans, Hastings, & Peacock (1993). The only known statistical distribution that could produce the observed shape is the distribution associated with the swallowtail catastrophe model which is simpler than the mushroom catastrophe, as discussed earlier.

Discussion

The results of the study showed that the leadership in an emergent situation is an exponential multimodal function, rather than a simple exponential function. Leadership was clearly not normally distributed as common measurement models would imply. The presence of multiple modes was predicted from early theory regarding personality and leadership (Cattell & Stice, 1954). There are many possible ways that leadership can be expressed; one type of leader exhibits the core leadership profile of traits, while secondary leaders fill more specific roles and would display a profile of traits germane to that specialty.

An important part of the exposition that is left unfinished is to define the dynamics by which the two types of leaders emerge, given that, in small groups, the main leader may not represent all the key characteristic of the generalized leadership profiles. An educated guess would suggest, however, that the emergence of the secondary leader would be predicated on the characteristics of the first. Thus it would appear, furthermore, that the emergence of leaders is a co-evolutionary process. At the present time, the dynamics of emergent leadership may be simpler than those represented by the theoretical N/K distribution (Kauffman, 1993).

Definition of the leadership situation that was used in this study may have inadvertently defined some constraints on the range of leadership types that could be observed. For instance, the group size could have easily imposed limitations on the number of actual leaders that could fill a leadership role. In the extreme, if all eight people were leaders, then no one was the leader. Large groups may offer opportunities for a wider variety of secondary leadership roles, either because of the group's geographic constraints, or because of subdivision of labor. In either case, the undifferentiated group appears to self-organize into functions. Further research could address the foregoing possibilities, which may offer at least partial explanations for what qualitative variables could be represented by the three swallowtail control parameters. If the qualitative aspects of leadership emergence could be successfully developed, the result may indicate, furthermore, that leadership can be understood as a ecological process as well.

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Chaos, Initiation (CONTINUED)

It is the difference between initiation and compulsion. One utilizes the creative capacity of chaos for transformation while the other drowns in disordered repetition. Initiation suggests a chaotic attractor, while drug addiction with its bipolar oscillation between tension and unconsciousness suggests the closed orbit of a limit cycle. (Abraham 1989, Abraham & Shaw, 1988)

Another parallel to initiation in our society or in any society is a consciously lived life. Through awareness of underlying stresses, a time of tension can be a far-from-equilibrium period with the chaos necessary for bifurcation. According to Eliade, (1974, 1975) the human condition is initiatory, where repeated struggles and breakthroughs in life are the ritual deaths and rebirths essential to self-development. Cyclical death and rebirth is found in Greek philosophy and in Christianity. Plato (1950) writes that life and death generate each other and Paul (I Corinthians 15:41) says "every day I die." If as Jung (1973) believes, that human nature demands a death and a rebirth for transformation then chaos may be a harbinger of change.

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THE SOCIETY FOR CHAOS THEORY
IN PSYCHOLOGY AND THE LIFE SCIENCES
29 HAYES ROAD
AMITY HARBOR, NY 11701 USA