Review by PFH

Hammond, Debora Ruth, Toward a Science of Synthesis: The Heritage of General Systems Theory. Ph.D. Thesis, Department of History, University of California, Berkeley, CA, 1997.

**** A history, survey, interpretation, and appraisal of the general systems movement with special attention to its instigators: Ludwig von Bertalanffy, Anatol Rapoport, Ralph Girard, James Grier Miller, and Kenneth E. Boulding. Considering that standard encyclopedias and other general reference sources do not acknowledge the general systems movement or its people, this is an invaluable reference, telling a story which very much needed to be told while it was still possible to do so. Most of the key people and salient notions from the heyday of the movement are mentioned, though only a few are discussed at length. The spirit of the movement as a socially-conscious, holistic, and sometimes political response to technologizing and corporatizing and industrializing and war-mongering in perilous times is set in contrast with the contemporaneous reductionistic attempts to apply conventional science and engineering to everything as in "scientific management," "operations research," and "systems analysis." Sources of concepts such as cybernetics, emergence, hierarchy, evolution, self-organization, allometry, open systems, and isomorphism are traced. Distinctions which have been made between systemic and systematic, analogy and homology, "soft" and "hard" systems, control gradient organicism and ahistorical mathematicism, homeostasis and heterostasis, equilibrium and non-equilibrium dynamics, technical (Shannon) "information" and semantic (Boulding) information, behaviorism and vitalism, cooperation and competition, expert and facilitator, etc., are clarified; and the eternal struggle between partiality and wholeness — and its socialization as the struggle between the individual and the collective — is considered. The various schools of ecology — organismic/holistic/cooperative, economic/competitive/systems, and evolutionary/population — are summarized. There are reminders that advocates of "critical systems" are apt to criticize the powers that be but do not by their mode of thought contribute much to critical thinking generally. "Circular hierarchy" and heterarchy are mentioned, but without elaboration or apparent appreciation.

It is evident how, despite their conscientious efforts to transcend the limitations they perceived in the fragmented disciplines, the founding general systemists remained trapped in the paradigms they deplored. Von Bertalanffy spoke of humanized science and claimed to be a loyal son of Heraclitus but could only itemize rigid premises such as "hierarchy" and "isomorphy" and "integration" and "homeostasis" when he was called to testify. He said that there was more to the world than mathematics could formulate, then lapsed into differential equations. He advocated a "general system theory" but could offer co credible plan for such a thing. After all, he could only say that the times called for a different unified philosophy, whatever it turned out to be. It is not surprising that his followers have been left ambivalent and confused. Anatol Rapoport attended to general semantics but resorted to mathematics and statistics rather than articulate the world whole. Perhaps that is how it happened that he "proved" via "game theory" that a "tit-for-tat" strategy is optimal, a conclusion belied only in actuality as the perennial give and take in the Middle East demonstrates. Boulding had a lot to say about knowledge and truth and belief at the interface of science and religion, some of it pithy, much of it anecdotal, all of it well-intentioned, none of it very effectual in the longer run. Miller never gave up his quest to reduce all natural organization and all human behavior to quantities measurable in "cgs" units. And Gerard's commitment to society as a superorganism only marginally explicates how so many people come to live as polyps in the descending colon of what passes for civilization. There have been plenty of conspicuous mistakes which have never been remediated in systems discourse: the assumption of the methods of classical science for all research and resulting models; the assumption of the conventional academic disciplines as givens to be reconciled by "interdisciplinary" means; the assumption that social systems and psychical systems and physical systems all follow the same principles; the assumption that classical logico-mathematical formulations are the best way to express theories. If there is one trap deeper than all the others, it is the mechanical paradigm of the industrial age. Whatever has been said to the contrary, discourse about general systems was and is couched predominantly in terms of formalism, structure, and morphology. Where there has been lip service to functionality and process it is in a mechano-morphic context. The general systems movement was never able to assimilate or to incorporate the topological insights from the cybernetics of Warren McCulloch and Heinz von Foerster, and for this reason more than any other it was doomed to chronic failures. Kenneth Boulding perhaps came closest to "getting it" with his attention to an image of images, knowledge of knowledge, and laws about laws. Such "second order" concerns make topological sense as toroidal orders of orders and thus quite properly call to mind McCulloch's *heterarchy* of values and von Foerster's second-

order cybernetics. As it turns out, systemicity itself may not be expressible in less than two complementary orders. While it is not really possible to speak of systems without making topological allusions, it is certainly possible to avoid acknowledging doing so, and such has habitually been the case in the systems discourse. It should be no surprise that the answer to the pathologies of the industrial age could not be found in more of the same. The Western rational tradition prevails unregenerate.

Like their successors in the systems movement, the founders proved not to be proficient designers of theories. In the case of Boulding, he offered many interesting insights and clever ideas but in aphoristic and anecdotal form, and his taxonomy of nine (or ten) orders of putative systems was not a productive theorization. As for Miller, his thousand odd pages of hypotheses about nineteen (or twenty) "critical subsystems" is an algorithmic expansion, a complication if anything, and not a theoremically economical core out of which richly meaningful consequences flow. Even the various definitions of "system" itself have been impotent. System as a recognition in perception (Rapoport), system as a controlling whole (Gerard), system as a mechanism of parts in hierarchical levels (Miller), system as an organism of parts (von Bertalanffy), and system as a meta-theory (Boulding) left matters adrift. Heinz von Foerster came close to a comprehension of systemicity and its ubiquitous role, but did not proceed to define or develop it in a communicable fashion. Technocratic definitions of "system" as a set with relations or a relationship between objects may satisfy mathematical and mechanical applications respectively, but not a world of other needs. In latter years, members of the SGSR/ISSS and ASC were heard to say that "system" cannot, indeed should not, be defined. Along the way, no one was heard to ask what counts as invariance, what happens at extremes, what limits are inherent, what accounts for ordination, and levels of what. It is little wonder that there is no such thing as systems theory or systems science worthy of the name. Nowadays "system" and "cybernetics" are conflated and equated with "computer stuff," so it probably no longer matters.

In order to change minds, the rationale has to change, and so do the semiotics. Do wordings really matter? Would things have gone better if Boulding had studied "development" first and foremost rather than "growth"? If Rapoport had sought "harmony" rather than "peace"? If Miller had been more concerned with "linkages" than with "levels"? If Gerard had cared more for "apperception" than for "organism"? If von Bertalanffy had been "non-disciplinary" rather than "interdisciplinary"? The late 20th century attention to semiotics by erstwhile affiliates of the general systems movement — a trend not mentioned in this thesis — may offer some answers, but only if it reckons with the topology of meaning.

This thesis is a substantial contribution to systems scholarship, especially if it is read as a chronicle of what went wrong with the general systems movement and a hint of how the world spins on as if it never happened. The work fills in many blanks and enriches the shelf of definitive references, taking its place beside Britton and McCallion's "An Overview of the Singer-Churchman-Ackoff School of Thought" (1995), Charles François' International Encyclopedia of Systems and Cybernetics (1997), Heinz von Foerster's Cybernetics of Cybernetics: The Control of Control and the Communication of Communication (1974, 1995), Walter Buckley's Modern Systems Research for the Behavioral Scientist: A Sourcebook (1968), and George Klir's Facets of Systems Science (1991). There is politicality evident in this presentation, just as there is politicality in the systems movement, and such is inevitable wherever people get together to say that the status quo is not good enough. The noteworthy irony is that a movement which started in a counter-culture came to be viewed as an apologist for established coercive authority. This is a reminder that in the absence of references such as this one, even the experts cannot tell the difference between "systems analysis" and "systemic thinking." Reductive positivism and its opposite have been mis-identified so closely that they are inseparable today. Thus does this work become a post-mortem account of where the general systems movement went wrong and how it failed.

Missing from this work is any consideration of Gerald M. Weinberg, who was a protégé of Boulding and of W. Ross Ashby. His An Introduction to General Systems Thinking (1975) remains the high water mark for presentations of systemic thinking and is minimum required reading if the potential of the general systems movement is to be appreciated. Although he never completed the planned trilogy of books to complement the ontology of cybernation with the epistemology of systemicity, Weinberg consolidated the important ideas of the general systems movement and advanced them, e.g., by showing how multiple perspectives debunk the notion of "superobserver" and how "laws" take on a life of their own. Although he departed the movement long ago, Weinberg was one of very few who were able to raise its message above cliché and platitude. His book and his teaching of "general systems" courses and symposia made the subject matter seem relevant to critical thinking about systemicity, and it made the movement appear coherent. There is no comparison between the level of presentation he made and that of

the founders or even of von Foerster. Unfortunately, in no small part because he stopped his contributions mid-course, systemists are left today in an irrelevant dead end with nothing but catchy buzzwords: "synthesis," "emergence," "autopoiesis," "proactive," "integration," "facilitation," "feedback" (misused), "isomorphy," "wholeness," "autocatalysis," and (as von Bertalanffy was fond of saying), "etc."

Weinberg made "general systems" look interesting; von Foerster made "systems cybernetics" look insightful. Who will make sense of it all? The present era is explicitly anti-philosophical, preoccupied with grubbing for pecuniary advances, and adversarial in the extreme. This may not be new under the sun, but it has become increasingly dangerous as population increases and resources decline. Sociology as a response to the disruptions of the industrial revolution has failed miserably, and all the systems conference manifestos of conscientious concern with the world situation, social relevancy, and service of mankind are not worth the paper they are printed on. "Interdisciplinary" or "multi-disciplinary" recombinations of reified partialities fix nothing. It is not surprising that unreasonable practices in the Western rational tradition persist, given that so many people perceive benefit in them. It seems remiss, however, that thoughtful people have not made sense of the alternatives, whether ancient as from Heraclitus or relatively recent as from von Foerster, Bohm, Weinberg, and kindred spirits. In particular, it seems derelict that the profound implications of McCulloch's heterarchy of values remain unexplored as a means for dissolving at last the endless quarrels about the "one right way." If, after all, a *system* — properly so called — is a persistent transformational gyre relative to an environment and relevant to a percipient, the deliberate ignorance which now sows the wind will surely reap the hurricane in due time.

Some telling quotes:

"... systems theory (is) in disrepute among contemporary scholars, in both the natural and social sciences, for a variety of reasons."
"The predominant conception of systems thinking within the academic community today is based on a limited understanding of the whole range of systems thought that fails to recognize the potentially progressive and liberating implications of some developments within the systems movement."
"(The) contrast between systemic conceptions which focus on interrelationships and dynamic processes, and the systematic conceptions which are more concerned with order, is critical in understanding the relationship between different views of systems in the twentieth century."
"The various systems approaches are all rooted in two fundamental premises: 1) 'Reality is regarded in terms of wholes,' and 2) 'The environment is regarded as essential.' "
"The growth of large-scale social organizations, made both possible and necessary by technological innovations, stimulated a growing interest in 'systems,' and 'systems analysis' became an umbrella term applying to almost any kind of broad interdisciplinary research."
"Americans celebrate the inventiveness of their entrepreneurs, but fail to understand the embeddedness of these inventions in complex technological and organizational systems."
"... reaction against the culture of war that seemed to be inextricably tied to ... technological rationality."
"Cybernetics ... emerges as a science of messages."
"... the cybernetic theory of feedback mechanisms reinforces a machine view of nature, and further, that the idea that nature is decomposable into systems implies that the systems analyst has a privileged vantage point external to the system, from which he is able to manage and control it." [Peter Taylor]
"In the wake of German fascism and Stalinist communism, competitive individualism prevailed, and cooperative organismic models in ecology gave way to more competitive economic models."
"Perhaps more than in any other field, (the) divergence in the applications and implications of systems ecology illustrates the paradoxical relationship between holistic/ecological and technocratic elements in the systems approach."
"... the ahistorical orientation of mathematical thinking ..."
"... both systems and population ecology incorporated equilibrium models, the first in terms of energy and the second in terms of populations."
"... large scale reduction of complex social phenomena to simple quantitative variables exemplified one of the besetting vices that (has been) identified with systems thinking." [Peter Taylor]
"... ecological concerns impinge directly on human society. Beyond the quantifiable elements of ecosystems and populations are qualitative and normative aspects that cannot be adequately addressed through science alone. It is the suppression of these value-laden aspects of the science that critics of the

systems approach address."
"In all its formulations ... positivism appeals to the authority of science as the basis for a rational understanding of the social order."
"... positivism marks a modern version of the Enlightenment belief in progress and the central role of science in the improvement of society."
"... positivism was initially motivated in defense of the freedom of human reason against the constraints of religion and traditional authority ... (but) it 'imposed its own unfreedom' in insisting that reason submit to experience, meaning that it is essentially constrained by present conditions ... (leads to) 'alignment of knowledge with the status quo' ... (and) represents the 'philosophic expression of technocratic domination.' In excluding normative considerations from science, 'technique' becomes a value in itself, and values tend to be expressed in terms of a technical rationality."
"All of the early social theorists placed considerable importance on the division of labor as a primary factor in the evolution of society, reflecting the industrial roots of modern social thought."
"Beginning with a radical theory of knowledge, with no Archimedean reference point, ... social theorists anticipated later cybernetic perspectives on consciousness and learning, in their emphasis on the experiential nature of knowledge based on trial and error feedback loops. They saw ethics as historical and contingent ... in their appreciation of the complementarity of rules and results in moral reasoning."
"... some of the difficulties with systems models stem from decisions about what to include in the system, as well as what kind of model to use."
"Bertalanffy's conception of general system theory arose out of his earlier work in theoretical biology, and his sense that biological organisms should be studied as wholes. In attempting to overcome the dicbotomy between vitalism and mechanism, Bertalanffy suggested that the unique characteristic of living systems was their organization ..."
"The general aim of Bertalanffy's approach was to determine principles that applied to systems in general, to classify logically different types of systems, and to work out mathematical models for describing them, with the ultimate aim of unifying science."
"... (Bertalanffy) constantly argued that the mechanistic view was rooted in a utilitarian conception, 'deeply connected with the economic outlook of the 19th and early 20th centuries,' that reinforced the Hobbesian view of society as the war of all against all. In addition, the basic conceptions of mechanistic science, such as strict causality, and the summative and random character of natural events, as well as the assumption of minimum interaction between parts and linear relationships between parts, were inadequate to explain the emerging problems in a wide range of disciplines. He saw GST as a new paradigm that was being elaborated, to some extent mathematically, in terms of uonlinear differential equations, but also in terms of verbal formulations, since there were clearly aspects of reality to which the language of mathematics did not apply. Most importantly, however, it offered a new world outlook or philosophy."
"... introducing his epistemological conception of 'perspectivism' in contrast to the reductionism of classical science, (Bertalanffy) stresses that all scientific constructs are models representing only certain aspects or perspectives of reality, and that other perspectives are both valid and necessary, including myth, poetry, and philosophy. In his words, 'every model becomes dangerous only when it commits the *nothing-but* fallacy.'"
"... GST as emphasizing models that were dynamic rather than static, molar rather than molecular, and formal rather than material."
"Principles that (Bertalanffy) thought could be applied to the study of ...systems included growth, regulation, hierarchical order, equifinality, progressive differentiation, progressive mechanization, progressive centralization, closed and open systems, competition, evolution toward higher organization, teleology and goal-directedness (etc.) He thought these concepts could contribute to the unification and integration of science//interdisciplinary synthesis, in a way that would provide for greater understanding than the previous unification through reduction of all sciences to the mechanistic conceptions of physics. In this way, he thought it would offer a framework for integrated education that would include ethical values and the development of the personality."
"According to Bertalanffy, the cybernetic model did not include metabolism and the open system model did not include information."
"Bertalanffy described GST as a Logico-mathematical discipline, similar to probability theory, with applications in diverse fields."
"Bertalanffy believed that the dominance of the stimulus-response scheme in psychology was connected with the 'zeitgeist of a highly mechanized society' and argued further that the behaviorist model ignored

the essential realms of play, exploratory activity, creativity, and self-realization, that were not encompassed by the principle of utility. In his view internal activity was primary and the process of stimulus and response was a regulative mechanism that was superimposed upon it."
"Bertalanffy saw the symbolic dimension of culture as an emergent property unique to human society that could not be reduced to biological drives, and argued, further, that symbolic universes were the most important part of the individual's behavioral system."
"... for Bertalanffy, values were culturally determined. He objected to the naturalistic view of humankind that reduced values to biological needs, drives, and principles. He also rejected the utilitarian conception of pleasure as the ultimate good, ..."
"Anticipating postmodern perspectives, (Bertalanffy) wrote that every symbolic world, including science, was 'a construct determined by innumerable factors of biological, anthropological, linguistic, and historical nature,' suggesting further that Western science was not the only possible kind."
"Referring to Heisenberg's discoveries relating to the interaction between the observer and the observed, Bertalanffy suggested that the systems concept required a new epistemology and a shift from an 'absolutistic' to a 'perspective' philosophy."
"(Bertalanffy) considered the ego boundary to be both fundamental and precarious, and yet, like all boundaries, 'ultimately dynamic.' "
"In a sense Bertalanffy's work might be compared with the programmatic work of seventeenth century philosopher Francis Bacon, who actually contributed very little of substance to the development of science, but gave it its vision, purpose, and direction."
"While ideological commitments often placed the emphasis in one direction or the other, systems theory in general highlighted the mutual causal relations between part and whole."
"For (Miller), the concept of system implies control; if something is uncontrolled, it is not a system."
"Miller defines power as control, 'the ability of one master system to influence in a specific direction the decision of a slave system at the same or another level."
"The concept of feedback, central to the cybernetic model, can be used to emphasize issues of (coercive) control, or to highlight the enigmas of circular causality. While the first orientation tends to reinforce predominantly deterministic models of behavior, the latter underscores the complex and paradoxical nature of the relationship between part and whole, granting a degree of relative autonomy to each level of organization."
"Gerard ... views social integration in terms of highly centralized decision-making processes where the interests of the individual are increasingly subordinated to the interests of the whole. Of course, he also assumes that individual interests are basically harmonious with the interests of the whole, but he fails to address adequately the conflicts between individual interests and how such conflicts are to be resolved. Although his writings are contradictory on this point, Miller at least entertains the possibility of a decentralized decision-making process, but he tends to view it in fairly deterministic terms, and his conception of values in terms of the elimination of strains is somewhat reductionist. Rapoport, on the other hand, is more sensitive to the potential for abuse of power, and highlights the subjective, symbolic dimension of values as an essential aspect of the general systems approach. This relationship, between the role of values and the nature of the decision-making process, is central to Boulding's work ..."
"While he believed that knowledge provided an essential basis for any kind of social change, (Boulding) constantly emphasized the importance of considering a wide variety of theoretical perspectives and practical approaches. His ideals were based on a pluralistic conception of the universe, that supported many centers of power and a diversity of ethical values. In his typical style, he suggested that pride was the greatest sin, because it interfered with the ability to learn."
"...(decision theory and management science) techniques confer an illusion of certainty, leading to premature closure in situations with a significant degree of uncertainty that require greater flexibility. And, of course, values and assumptions are implicit in these models, in the choices of variables and the definition of their mutual relationships, not to mention the determination of ends to be maximized."
"(Boulding) described science as merely one subculture among many; and the scientific method as merely one of many methods whereby images change and develop, ... anticipating more recent currents of thought on the objectivity of science ..."
"Do (systems) models simply facilitate greater social control and contribute to the power of established authority, or, by taking a broader global view, might they offer insights into the possibility of more truly participatory forms of social organization?"
"(Boulding worked) throughout his life toward a conception of wholeness that could balance diversity and

contain polarities in a way that would leave room for individual growth and variety."
"... (Boulding) argued that knowledge which does not take into account a multiplicity of views is inadequate."
"A recurring theme in (Boulding's) work is the necessity, at every level of organization, for continual reexamination of fundamental assumptions and beliefs, demonstrating a level of self-awareness and reflexivity ..."
"... the primary goal of the SGSR) was to 'encourage the development of theoretical systems which are applicable to more than one of the traditional departments of knowledge,' and with principal aims as follows: '1) To investigate the isomorphy of concepts, laws, and models in various fields, and to help in useful transfers from one field to another; 2) To encourage the development of adequate theoretical models in areas which lack them; 3) To eliminate the duplication of theoretical efforts in different fields; 4) To promote the unity of science through improving the communications among specialists.' "
"While Miller identified essentially the same nineteen to twenty subsystems at every level of organization, Boulding's model implied a different order of complexity at the symbolic and social level of organization because of the greater importance of information and knowledge."
"To some extent, the evolution of information systems reflects changing models in organizational theory, with a corresponding shift from hierarchical to heterarchical models, emphasizing decentralization, autonomy, and flexibility, as well as collaborative leadership, and increasing access to data."
"... the notion of 'total systems intervention,' along with the definition of systems practice as 'intervention in society intended to bring about improvement,' highlights the ambivalence of the systems practitioner's role in such attempts to change the values and orientation of management."
"Postmodern critiques portray systems thought as a totalizing meta-narrative, lending itself to oppressive forms of control and manipulation."
"In many ways, ... emphasis on 'things in context' reflects postmodern concerns. Considering systems in relation to their environment does not imply a commitment to downward causation; on the contrary, it highlights the creativity and adaptability of individuals in relation to each other and to the natural environment. A global perspective does not necessarily entail a totalizing conception of reality."
"Clearly, the language of reconciliation is suspect for good reason, since it has so often been coopted in the interests of existing power structures, and it is important to acknowledge the 'structural violence' inherent in homeostatic models. on the other hand, Kenneth Boulding's concern with the destructive impact of dialectical models that emphasize conflict as the primary motive force in society, is legitimate. An ideological commitment to conflict seems to characterize both the right and the left in contemporary politics, the right in terms of competitive individualism and the left in terms of difference and particularity. Both play into the hands of the powers that be, justifying violence and legitimating various forms of exclusion. A truly inclusive view of nature and society as self-organizing and creative systems implies dispersed agency rather than centralized control, as well as a belief in the ultimate reconcilability of individual aspirations."
"General systems theory should be understood as a mode of inquiry rather than as a rigid model of nature."

Contents:

Concepts:

active systems	adaptation	adaptive planning	agonistic
allometry	altruism	anabolism	analogy
analysis	analytic	anamorphic	anti-reductionist
anti-system	appreciative systems	artificial intelligence	autocatalysis
autonomy	autopoiesis	behavior	behavioral sciences
behaviorism	biocoenosis	boundaries	capitalism
catabolism	causality	centralization	chaos
choice	circular causality	circular hierarchy	Club of Rome
coaction	codes	coding	cognitive science
collectivism	communication	communications engineering	communism
competition	complexity	computers	conflict
conscience	consciousness	consensus	consent
constructivism	control	control engineering	cooperation
critical self-reflection	critical subsystems	critical systems	critical theory
cross-level hypotheses	culture	**cybernetics**	cyborg
decision-making	decision theory	decomposition	democracy
descriptive	determinism	dialectical models	dialectical process
differential equations	differentiation	directiveness	division of labor
DNA	downward causation	dualism	ecology
econometrics	economics	ecosystems	education
eiconics	emancipation	**emergence**	emergent evolution
empiricism	empowerment	energy	engineering
entelechy	entropy	environment	environmentalization
epiorganism	epistemology	equifinality	equilibrium
equilibrium models	equilibrium processes	equipotentiality	**evolution**
evolutionary ecology	expert	facilitation	**feedback**
field theory	flow equilibrium	freedom	free will
functions	functional circuit	functionalism	gaia hypothesis
game theory	general semantics	general system(s) theory	gestalt psychology
goal	goal-directed	governors	**growth**
habitus	hard systems	hermeneutics	heterarchical models
heterostasis	heuristic analysis	**hierarchy**	history
holism	holistic	holistic materialism	homeostasis
homology	human activity system	human ecology	human engineering
humanism	humanization	humans	idealism
identity	ideology	idiographic	individual agency
individualism	individuals	industrial relations	influence
information	information theory	institutionalism	instrumental
instrumental rationality	interactions	**interdisciplinary**	interrelationships
interstitial fields	intervening variables	interventions	**isomorphism**
language	learning	levels	levels of organization
liberalism	liberation	linearity	linear programming
living systems	logical positivism	machine metaphor	management science
marxism	materialism	meaning	mechanism
mechanization	memory	messages	meta-conference
meta-narratives	modeling	**models**	morphogenesis

multidisciplinary	multiple perspectives	mutual causation	natural selection
nature	negative feedback	networks	neurophysiology
nomothetic	non-zero-sum	noosphere	normative
nucleation	observer	**open systems**	operationalism
operations research	order	org	organic mechanism
organism	**organismic approach**	organismic biology	organismic ecology
organization	organizational structure	organization theory	organizing relations
panpsychism	particularist	parts	perceptions
personality	perspective	perspectivism	physicalism
planning	politics	population dynamics	population ecology
populations	positive feedback	positivism	postmodernism
power	pragmatism	probability	processes
program planning & budgeting	progress	psychology	purpose
purposeful behavior	purposive	qualitative	quantitative
random	rational	rationality	rational management
reactive systems	realism	receptors	**recognition**
reduction	reductionism	reflexivity	regulation
relationships	relativism	robotization	roles
schismogenesis	science	scientism	second order cybernetics
self	self-control	**self-organization**	self-regulation
semantics	servomechanisms	simulation	social Darwinism
social determinism	social dynamics	social ecology	social engineering
socialism	social organism	social psychology	social sciences
social systems theory	society	sociology	sociology of knowledge
soft systems	statistics	stimulus-response	structural determinism
structural functionalism	structuralism	structure	subsystems
summative	superorg	sustainability	sustainable economics
symbiosis	symbolic interactionism	symbolic systems	synergy
synthesis	systematic	system dynamics	systemic
systems	systems analysis	systems approach	systems dynamics
systems ecology	systems engineering	systems movement	systems perspective
systems philosophy	systems science	systems technology	systems thinking
systems theory	taxonomy	technocracy	technocratic
technology	teleology	thermodynamics	thermostat
topology	totalitarianism	totalization	totalizing
total systems intervention	totipotential	transformations	truth
uncertainty	unity of science	utilitarianism	utility
values	viable systems	vitalism	war
wholeness	wholes		

Distinguished References:

Russell L. Ackoff	Timothy F.H. Allen	Gordon Allport	A.-M. Ampere
Chris Argyris	Aristotle	W. Ross Ashby	Francis Bacon
Bela H. Banathy	Gregory Bateson	Stafford Beer	Henri Bergson
David Berlinski	J.D. Bernal	Claude Bernard	Kenneth Boulding
P.W. Bridgman	Walter Buckley	Ernest Burgess	Walter Cannon
Fritjof Capra	Peter Checkland	C. West Churchman	Frederic Clements
Barry Clemson	Barry Commoner	Auguste Comte	Charles Darwin
René Descartes	Karl Deutsch	John Dewey	Wilhelm Dilthey
Hans Driesch	Emile Durkheim	Sir Arthur Eddington	Albert Einstein
Jacques Ellul	Fred Emery	Richard Ericson	Raul Espejo
Gustav Fechner	Enrico Fermi	R.A. Fisher	Robert Flood

Jay W. Forrester	Sigmund Freud	Erich Fromm	Brian Gaines
J. Willard Gibbs	Franklin Giddings	Ralph Girard	William Gray
Bertram Gross	Jürgen Habermas	J.B.S. Haldane	Alexander Hamilton
Nicolai Hartmann	S.I. Hayakawa	Georg Hegel	Werner Heisenberg
Hazel Henderson	Lawrence Henderson	Heraclitus	Ida Hoos
Max Horkheimer	David Hume	G. Evelyn Hutchinson	Aldous Huxley
Julian Huxley	I Ching	Michael Jackson	William James
James Jeans	John Maynard Keynes	George Klir	Arthur Koestler
Wolfgang Kohler	Alfred Korzybski	George Lasker	Gottfried Leibniz
Kurt Lewin	Robert Lilienfeld	Harold Linstone	Alfred Lotka
James Lovelock	Niklas Luhmann	Jean-François Lyotard	Macy Foundation
Thomas Malthus	Karl Marx	Abraham Maslow	Humberto Maturana
James Clerk Maxwell	Otto Mayr	Warren McCulloch	D.H. McNeil
George H. Mead	Margaret Mead	Robert Merton	James Grier Miller
C. Lloyd Morgan	Lewis Mumford	Joseph Needham	Harold Nelson
Howard T. Odum	Vance Packard	Vilfredo Pareto	Robert Park
Talcott Parsons	Gordon Pask	Charles Sanders Peirce	Jean Piaget
Plato	John R. Platt	Karl Pribram	Ilya Prigogine
Anatol Rapoport	Nicholas Rashevsky	William Reckmeyer	Lewis Richardson
Robert Rosen	Arturo Rosenblueth	Milton Rubin	E.S. Russell
Henri de Saint-Simon	Kjell Samuelson	Paul Samuelson	Moritz Schlick
Donald Schon	Erwin Schroedinger	Peter Senge	Claude Shannon
Conrad Sherrington	Georg Simmel	Herbert Simon	E.A. Singer
Adam Smith	Maynard Smith	Jan Smuts	Pitirim Sorokin
Herbert Spencer	Oswald Spengler	William Graham Sumner	Leo Szilard
Arthur Tansley	Tavistock Group	Frederick Taylor	Pierre Teilhard de Chardin
René Thom	D'Arcy Thompson	Eric Trist	Len Troncale
Werner Ulrich	Stuart Umpleby	Francisco Varela	Thorsten Veblen
Geoffrey Vickers	Vito Volterra	Ludwig von Bertalanffy	Christian von Ehrenfels
Heinz von Foerster	John von Neumann	Conrad Waddington	Alfred Russell Wallace
Leon Walras	Lester Ward	John Warfield	Kenneth E.F. Watt
Warren Weaver	Max Weber	Paul Weiss	Heinz Werner
Alfred North Whitehead	Benjamin Lee Whorf	Norbert Wiener	Joseph Woodger
Zinchang Zhu			