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THE ROLE OF GENERAL SYSTEMS THEORY IN THE CONCEPTUAL SYNTHESIS OF THE COMING AGE

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The Need for Conceptual Synthesis

Every age produced a synthesis of its most trusted items of knowledge. The synthesis has been more or less explicit, farranging and logical: and it has had various success in satisfying the cognitive needs and practical problems of its age. But there has never been an age of human civilization without some degree of integration in its fields of knowledge and the use of the integrated system in the guidance of its practical affairs.

Ours is perhaps the most diversified, least integrated, and most diffusely applied body of knowledge mankind has yet produced. It is also the most exact one on specific, fragmented areas, and the most operational. That it produced the greatest disorder in the terrestrial household of man is little wonder. It is likewise obvious that unless we integrate and focus our knowledge the disorder will grow into disaster.

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Without the synthesis of the items of knowledge held valid in a society, no individual or collective long-term purposes can be identified and rationally pursued. The more precise the knowledge system, the sharper the dynamics of the human processes oriented toward identified goals and conscious purposes. In the past, the synthesis of knowledge was based on items accepted on faith, and handed down in the culture's traditions. Even such syntheses faced concrete tasks in the orientation of action, since bodies of knowledge which gave consistently false directions were soon phased out in the process of natural selection acting on the biological bases of cultural systems: the misdirected population was assimilated in more viable cultures, or faced extinction. This is not to say that every viable synthesis produced universal satisfaction; merely that it offered sufficiently tested orientations to enable the population subscribing to it to survive. A group of conscious beings will not rely on instinct alone any more than on blind habit and unreflected tradition. Every major decision is justified in terms of a knowledge scheme, but every knowledge scheme is tentative and open to re-examination. Ineffective knowledge schemes are either replaced, or the population suffers for their continued beliefs. Viable civilizations constantly modify their syntheses to keep them functional. Thus a long sequence of conceptual syntheses unfolds in history, each scheme holding sway for a time, to be succeeded by more updated and efficient modes of thought and views of the world. In the ancient Western world, great writings committed to paper and copied by learned scholars served as pivotal points of the synthesis of knowledge. There was the Jewish Bible: the epics of Homer and the Theogony of Hesiod: the works of Aristotle, and the encyclopaedias of Varro and Pliny. In the Middle Ages these syntheses of classical knowledge were elaborated by Christendom and Islam. The former produced Augustine's City of God, Justinian's Corpus Juris Civilis, the Etymologies of Isidore, and the Summae of Thomas Aquinas. Islam produced the Koran and such works as Al-Farabi's Book of Traditions, Avicenna's Book of Recovery, and Ibn Khaldun's Universal History.

Oriental civilizations produced their own syntheses of knowledge, and their own great texts stating particular formulations. In ancient India, the major syntheses were stated in the Vedas, the Upanishads, the Puranas, the Bhagavad Gita, and the works of six major schools of Hindu philosophy. In China the great expressions of synthesized knowledge were the Confucian canon, the systematic historical records of Ssu-ma Ch'ien and his successors, and the encyclopaedias such as the T'ai-ping yü-lan of Wu Shu and Li Fang.

With the rise of modern science, the Western synthesis took on a mixed character. The ideal of pure inductive knowledge became incompatible with the acceptance of great metaphysical syntheses handed down from past ages. Bacon's Novum Organum, the works of Descartes and Leibniz, the "natural philosophy" propounded in the language of mathematics by Galileo and Newton, produced a fundamental rift in the knowledge systems of our forefathers. Religious systems were separated from scientific systems, and our conceptual synthesis was split into a "natural" and "moral" philosophy.

Attempts at producing inclusive world views were made by system building philosophers, such as Spinosa, Hegel, Spencer. The project was also taken up by the French Encyclopedists, who hoped to produce a synthesis by cataloguing the items of concurrent knowledge. A large segment of civilization came under the spell of the conceptual synthesis produced by Hegel, Marx and Lenin, but most Western societies learned to live with a world view fundamentally split into scientific and religious-moral components. Oriental civilizations came increasingly in contact with the Western world through faster and broader channels of communication, trade and transportation, and partly surrendered, partly shifted their own integrated conceptual systems to accommodate the new influences.

Presently all boundaries between cultures are rapidly disintegrating. It will no longer be possible to simultaneously uphold several incompatible conceptual syntheses valid for different people at different places. Our bodies of knowledge are as interdependent as our patterns of life. There is only one science for East and West, and though there are many religions and belief systems, they are becoming insignificant in terms of their influence on the operative knowledge of the age.

We are headed toward a global civilization and, as all previous, smaller-scale civilizations, it too, will produce a conceptual synthesis. This synthesis can also be more or less explicit, far-ranging and logical, and it can have more or less success in satisfying concrete needs for guidance in the processes of human affairs. We cannot see into the future and predict what the nature and success of the coming world order will be like. But we can say that <u>if</u> the coming world order will be a viable one, its conceptual synthesis will be explicit, far-ranging, scientifically based, and pregnant with normative guidelines for practical behavior.

Conceptual syntheses perform at least five basic functions in the guidance of human affairs. They are the mystical, the cosmological, the sociological, the

* in fact, what he says is exactly true. The operative knowledge of our age is quite independent of religions

edagogical or psychological, and the editorial functions. The mystical function ıspires in man a sense of mystery and profound meaning related to the existence of ıe universe and of himself in it. The cosmological function forms images of the ıiverse in accord with local knowledge and experience, enabling men to describe ıd identify the structure of the universe and the forces of nature. The sociological ınction validates, supports and enforces the local social order, representing it s in accord with the nature of the universe, or as the natural or right form of ocial organization. The pedagogical or psychological function guides individuals ırough the stages of life, teaching ways of understanding themselves and others nd presenting desirable responses to life's challenges and trials. Finally, the ditorial function of conceptual syntheses is to define some aspects of reality as nportant and credible and hence to be attended to, and other aspects as worthy nly to be ignored or repressed.

In today's world, most of the traditional functions of cognitive syntheses ave atrophied and lie ignored and neglected. Mythology is currently relegated o the status of mere superstition: man is no longer inspired by a sense of mystery nd profound meaning in life and the universe. Religions suffer from a credibility ap and concentrate increasingly on problems of community relations and social ustice. Contemporary science has assumed the role of forming our images of the niverse and of human nature, but its disclosures come in a highly disjoined, tomistic manner, and are wrapped in the esoteric jargon of mathematics and pecialty languages. Thus the meaning of scientific knowledge fails to penetrate he fabric of society. Bureaucrats and civil servants, who make no claim to nderstand or even to seek a larger picture of reality, carry out the sociological unction of administering and enforcing local social orders. The pedagogical or ducational function of guiding individuals through the stages of life has been elegated to secular institutions of mental health and psychotherapy, traditions aving faltered and then completely failed in advanced

industrial societies. The editorial function is now administered by technocrats, public relations experts, and the funding agencies which steer the processes of large-scale research and development. All of these functions, insofar as they are performed, originate from separate groups with fragmented and often mutually incatible world views. Aside from a few countries, which are actively engaged in fighting for their existence, or carrying out revolutions to catch up with their peers (e.g., Israel, North Vietnam, China), contemporary societies suffer from a lack of meaning and guidance, due to the atrophy and fragmentation of their conceptual synthesis. Alcoholism, drug-addiction, suicide and divorce rates, crime and corruption, are sharply on the rise; a sense of purpose, a vital image of the future, and meaningful individual and societal goals are lacking. Yet humanity needs a sense of purpose, a vital image of the future, and meaningful individual and societal goals now more than ever before in history. There has never been a period in history when there was so much need for purposively guided transformation, and so little room for error, than today. The industrial-state
18 complex creates progressively more problems and consistently reduces the error-threshold of its viable transformation. Times are past when a conceptual synthesis could fail to perform on all counts, or dictate partially counterfunctional patterns of behavior. With the advent of the contemporary global community of interdependent, partly highly technological societies, insufficient and incorrect guidance and motivation results in major breakdowns and the suffering of millions of people. This is why the coming conceptual synthesis will have to operate on all levels, and why its main inspiration will have to be based on the sciences. By calling for a "scientific" synthesis we do not call for a universal worship of science and the view that all our knowledge is either derived from the sciences or is plainly nonsensical. That the inspiration of our conceptual synthesis must be based on science does not mean that it must be limited to the scope of contemporary validated scientific theories. It must extend, on the contrary, to all the functions which conceptual synthesis have traditionally performed. But inasmuch as it suggests

ιidelines for concrete action, it must respect the reduced error-tolerance of the ontemporary situation: hence it must base itself on the empirically tested knowledge ccumulated in the sciences. Science is a body of knowledge which is hallmarked by ie fact that it is constantly tested against experience (as well as, to some extent, gainst rival theories) under controlled conditions. This fact recommends science s the mainspring of our conceptual synthesis in view of our reduced degrees of reedom in effecting the needed societal-cultural transformations. This same fact oes not mean that we can afford to restrict our synthesis to science, for cience makes a poor religion, an inadequate basis for morality, for existential eaning and for individual and collective purpose. Our conceptual synthesis will ave to be scientific at its core, but move beyond the concurrent reach of the ciences in satisfying our demands for coherence in the more esoteric regions of uman experience. Binding the scientific and spiritual domains, the new knowledge ust remain coherent and self-consistent, replacing the incoherence, and the tacit s well as overt contradictions traversing the scientific, religious and oral components of our system of ideas.

The new conceptual synthesis cannot content itself with remaining a plaything f the mind, cherished and cultivated in isolated ivory towers of learning and culture. vory tower philosophy and "pure" science may continue to be pursued by a small umber of researchers for the intrinsic value of gaining knowledge for the sake f knowledge, but the bulk of the conceptual synthesis will have to be moved y concerned investigators into the worldly arena of practical application. There, ts task will be to suggest the norms by which the global civilization of man can e purposefully guided, and also the detailed processes whereby such guidance can e effected. Fragmented knowledge, even if deriving directly from the sciences, s incapable of fulfilling this task. It treats the many systematically inter-ependent factors of global existence as the separate domains of disciplinary erritories, each jealously guarded by specialists well endowed with the instincts f cognitive territoriality. The human future can only be assured by a synthesis based on science but integrating the relevant pieces of scientific knowledge with one another, and thus integrating scientific knowledge with those insights that have been won without benefit of scientific method but which have nevertheless proven to be meaningful in themselves, and valuable in guiding the imagination and focusing the thrust of human motivation.

Prospects for a Scientific Synthesis

Although a fully scientific conceptual synthesis is unlikely to occur in the foreseeable future (and could occur in the distant future only if many phenomena now recalcitrant to quantitive measurement and prediction become accessible to scientific treatment), the chances of producing a scientific synthesis sufficient to provide the basis for a new conceptual synthesis are quite good. This moderately optimistic assessment is based on two observations. First, on the intrinsic trend within science itself to maximize the scope of theories consistently with their precision. Second, on the intrinsic pressures on science for transcending traditiona disciplinary boundaries in producing coherent and applicable bodies of knowledge.

(1) Modern science has made great progress by adopting the basically analytica method of identifying and if possible isolating the phenomena to be investigated. If effective isolation is not feasible (for example, in the life and the social sciences), it is replaced by the theoretical device of averaging the values of inputs and outputs to the investigated object, and varying the quantities with the needs of the experiment. Thus influences from what has often been disparagingly called "the rest of the world" can be disregarded. It appears, however, that "the rest of the world" is an important factor in many areas of investigation. The consequences of disregarding it are not immediately evident, for a good detailed knowledge of the immediate phenomena in a short time-range can nevertheless be won. But the spin-offs, or side-effects, of the phenomena will be incalculable, and such effects are not the secondary phenomena they were taken to be in the past. They are the results of the complex strands of interdependence which traverse all realms of empirical

ɜstigation but which science's analytical method selectively filters out. Hence get much detailed knowledge of local phenomena, and a great deal of ignorance of interconnections between such phenomena. The analytical method produced the losion of contemporary scientific information, and the dearth of applicable entific knowledge. It has also engendered wasteful parallelisms in research to failures in the transfer of models and data between disciplines. Yet, to many entists and philosophers of science, the advantages of specialization outweigh its advantages, and they are not discouraged by the prospect of further specialization segmentation in the evolution of science.

However, there are factors operating within the scientific enterprise which correct the deficiencies of overspecialization through the development of new, more tegrated theoretical frameworks. Modern science has had long experience in dealing th explosions of data and proliferations of theory, and was quite successful in ntaining them in the past. Galileo, Kepler and Newton provided broad conceptual hemes for integrating observations in physics and astronomy; Darwin provided the ster scheme for biology. When the Newtonian synthesis encountered anomalies, nstein proposed a new framework for reinterpreting data in a more consistent and tegrated manner. Scientists have always sought, in Einstein's words, "the simplest ssible system of thought which will bind together the observed facts."[2] From pler, who had hopes of understanding the Plan of Creation, to Heisenberg, who spite the complexities of quantum physics maintained that what the physicist seeks to penetrate more and more reality as a great interconnected whole,[3] we can perceive search for theories that respond to the scientist's appreciation of elegance and curacy combined with integral scope and extensibility to neighboring fields and yet uninvestigated phenomena. Theories are required to be "fertile" not only explaining and predicting already known observations and processes, but in enerating specifying theorems which can deal with new observations and presently ecalcitrant or anomalous processes. This requirement blurs the distinction between iscovery and invention, and moves contemporary science beyond the traditional confines of classical empiricism and its neopositivist restatement.

It is instructive to review the contributions of great theoretical scientists in reference to the degree of integration, abstraction and generality they introduced in their field.[4] Scientists value theory-refinement as well as theory-extension, although they do so to differing degrees. The routine experimentalist, mainly involved with puzzles that can be solved through a suitable application of existing theories and techniques, tends to disparage the "philosophizing" of colleagues bent on the revision and refinement of the theories themselves.[5] But scientists who perceive internal inconsistencies in their frameworks of explanation are greatly concerned with overcoming them through the creation of new, more general postulates, embracing existing theories as special cases, or reinterpreting them in the light of new axioms. Although the emphasis changes from person to person, scientific community to scientific community, and from period to period depending on the problems encountered in the given field, it remains true that, on the whole, the progress of science involves the integration of loosely joined lower level concepts and hypotheses in mathematically formulated general theories. As Conant said, two streams of human activity, separated until the sixteenth century, gradually came together. These were abstract reasoning, as represented by the work of the metallurgists who over the generations had improved the methods of winning metals from the ores. As a result, we can view science as "a dynamic undertaking directed to lowering the degree of empiricism in solving problems; or...a process of fabricating a web of interconnected concepts and conceptual schemes arising from observations and experiments and fruitful of further experiments and observations."[6]

(II) The historical trend is to counterbalance segmentation and specialization in patterns of research and experimentation. However, when great progress is made by means of specialized research, corrective measures could be suspended for decades or even centuries; hopes for a scientific synthesis may be dim if we had to rely on trends intrinsic to science alone. But a powerful ally of the theoretician's dream of elegant and integrated theories has emerged in recent years in the guise of extrinsic demand on science to deliver theories capable of societal application. s demand unfolds as a consequence of the excessive fragmentation of scientific a with respect to operational utility. For example, our knowledge of the environ- t is segmented into academic compartments, but the environmental factors themselves m an interdependent continuum. As a result there has been a marked shift in public port for scientific projects. The new pattern of allocations favors research that s social utility either by having direct applications, or by clarifying norms or hniques relevant to applications. At the same time, the meaning of applied science s been gratly enlarged. It is no longer restricted to the kind of activity designed produce labor saving energy conversion devices and processes for the manufacture goods. Applied science now also includes the "software" of new social technologies, e fruit of research into human behavior, social organization, and the management human and natural resources.

The new patterns of resource allocation reflect society's rising need for scientific synthesis of its operationalizable bodies of knowledge. Such bodies knowledge seldom result from research carried out from within the compartments traditional scientific disciplines. In almost every case, concrete societal oblems call for interdisciplinary research and the integration of hitherto parately investigated variables. There are no problems that can be fully resolved thout impacting at the same time on the resolution or aggravation of other oblems--as Garrett Hardin said, we can never do "just one thing." We live on a nite planet and constantly increase our dependence upon the earth's bio- gical and energy resources. Disciplinary compartmentalization is useful only it is coupled with transdisciplinary integration. This demand is not likely eliminate specialized research for the sake of gathering knowledge independently f its potential of application, for such research continues to be an ideal of cience and, beyond that, of human civilization. But the scientific enterprise as whole is likely to feel the effects of societal pressures for applicable knowledge, nd these effects will include a relative de-emphasis on specialized research for the sake of pure knowledge and a strong emphasis on all research that can jointly produce operational results.

The Promise of General Systems Theory

General systems theory arose in the last few decades specifically as a response to the contemporary need to counterbalance fragmentation and duplication in scientific research, induced by ultraspecialized modes of inquiry. Von Bertalanffy justly regarded as its founder, summed up the aims of General Systems Theory in reference to the following points:

(1) There is a general tendency towards integration in the various sciences, natural and social.

(2) Such integration seems to be centered in a general theory of systems.

(3) Such theory may be an important means for aiming at exact theory in the nonphysical fields of science.

(4) Developing unifying principles running 'vertically' through the universe of the individual sciences, this theory brings us nearer to the goal of the unity of science.

(5) This can lead to a much-needed integration in scientific education.[7]

18 In view of the contemporary needs in the practical domains, we may add,

(6) Bringing us closer to the unity of science and the integration of scientific education, this theory could provide a basis for a conceptual synthesis capable of fulfilling the time-honored, but presently unfulfilled, functions of conceptual guidance and individual and collective motivation.

The stated aims of the society created to promote general systems thinking, the Society for General Systems Research, include corresponding ideals:

(1) To investigate the isomorphy of concepts, laws , and models in various fields, and to help useful transfers from one field to another.

(2) To encourage the development of adequate theoretical models in fields which lack them.

(3) To minimize the duplication of theoretical effort in different fields.

(4) To promote the unity of science through improving communication among specialists.[8]

To these aims, we may likewise propose adding another,

(5) To promote and encourage the application of unified scientific knowledge in the area of concrete societal problems, for the benefit of individuals, societies, and mankind generally. Ap. 54

General Systems Theory, as other innovative frameworks of thought, passed
rough phases of ridicule and neglect. It has benefited, however, from the
rallel emergence and rise to eminence of cybernetics and information theory,
d their widespread applications to originally quite unsuspected fields. Presently,
e rise of this theory is aided by societal pressures on science, calling for the
velopment of theories capable of interdisciplinary application. General systems
eory grew out of organismic biology, and has soon branched into most of the life
d behavioral sciences. Its recent applications include the areas of social work,
ntal health, the political sciences, and the humanities.[9] Its extention to the
w field of studies rallying around the concept of "world order research" is a
gical next step.

The specific contribution of general systems theory derives from its
-emphasis of traditional concepts of matter, substance, idea or spirit,
d its explicit orientation toward grasping phenomena in terms of organization.
rganization" can be loosely defined as structure (in space) and function (in
me). Structure and function are not rigorously separable, however. That which
s structure is the record of past functions and the source of present ones. Function
n turn is the behavior of structure and the pathway leading to the formation of
w structures. The relativity of the concepts derives from the dominance of the
oncept of organization. Not what a thing is, what it is made of, or for what purpose
t exists, defines it, but how it is organized. Its organization specifies the internal
elations of the events which constitute it, and the external relations of the con-
tituted entity and other entities in its environment.

The simplest conceptualization of an entity defined by its organizational
nvariance is system. A system in this definition is a collection of parts conserving
ome identifiable set of (internal) relations, with the summed relations (i.e. the
ystem itself) conserving some identifiable set of (external) relations to other
ntities (systems).

The definition tightens considerably when we consider that if any set of events
onserves identifiable sets of internal relations, it must be endowed with the
haracteristics of pattern-maintenance, i.e., it must be capable of at least

temporarily withstanding the statistical outcome of disorganization predicted by the second law of thermodynamics. There must be organizing forces or relations present which permit the conservation of structure (and function). A set of events not possessing such characteristics conserves an identifiable set of internal relations only if externally constrained (e.g., the molecules of a gas kept at constant pressure and temperature). Otherwise the relations tend to degrade until a state of thermodynamical equilibrium is reached. A set of events which does not degrade its organization to thermodynamical equilibrium in virtue of the balance of its internal relations with its external relations is a natural system. It may be contrasted with sets of events of which the internal relations are artificiall constrained to remain invariant: artificial systems.

The noteworthy fact is that with the exception of human artifacts, almost all the things we can identify as "the furniture of the earth" are natural systems, or parts of natural systems, or aggregates formed by natural systems. Stable atoms are natural systems, and so are molecules, cells, multicellular organisms, and ecologies. It may well be that complex human sociocultural systems, and indeed the global system itself, form natural (rather than artificial) systems. This is important, for certain general propositions are true of natural systems, regardless of their size, origin, and complexity, which may not be true of artificial systems. These propositions are true in virtue of the fact that in a universe governed by uniform laws certain sets of relationships are required to conserve and enhance order over time. Much can be understood of the system's basic "nature" by assessing its behavior in reference to the imperatives of natural system dynamics.

The promise of general systems theory consists in (1) discerning natural systems in diverse areas of investigation, i.e. identifying those real entities which can by analyzed in terms of general systems laws, (2) providing an inventory of natural systems from atoms to ecologies and possibly to social systems and the world system, (3) formulating the general principles accounting for the evolution of systems on multiple hierarchic levels, crossing the boundaries of the inorganic-

ganic, the organic-multi-organic, and their many subdivisions, and (4) referring
osen problems of philosophic-scientific-humanistic interest to the systems
alysis of the relevant phenomena, carried out in the context of the integrated
heme of hierarchically organized natural systems.

In the integrated analysis of complex organizations, the norms for the subsystems
e given in the suprasystems. Health for the human organism is the norm for the
nctioning of its organs and cells, and viability for a culture is the norm for the
nctioning of its institutions, organizations, and individual members. Likewise,
e long-term capability of persistence of the world system is the norm for the
havior and functioning of its national and regional subsystems, including their
onomies, ecologies, and domestic and foreign policies.[10] By relating functional
ganization from level to level, we can comprehend the contribution of subsystems
larger systems and, proceeding in the reverse direction from suprasystem down-
rds, we can evaluate the performance of subsystems against objective norms.
ing conscious human beings, our vital interests reside in the survival of our
ecies and the unfolding of our civilization. In the perspective of general
stems theory we can understand the objective norms which we, and our institutions,
ist respect if our basic objectives are to be realized. These are the norms of
xistence of the world system, encompassing all of mankind with its ecologic-
conomic life-support systems, in a manner that permits the optimum level of
reedom of decision to human individuals without endangering the conditions of
xistence of future generations.

The norms of long-term existence for the global community of man must be
arefully researched. This writer has recently formulated a research plan designed
o bring to light the basic requirements of global community, as well as the conditions
nder which the requirements can be satisfied.* Its three phases include (1) determining
he requirements for global community; (2) establishing the relation between the
equirements for global community and current trends and practices; and (3) specifying

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A draft of the Proposal is attached herewith.

the practical feasibility of transforming current trends and practices to meet the requirements for global community.

General systems theory is a basic tool of research into conditions of global community. It permits the investigator to conceptualize this community as a high-level system, and relate to its norms of long-term persistence the behaviors of its functional subsystems, including human life-styles and decisions. In this way he enables us to see the forest in addition to the trees, and to understand that the persistence of the whole forest is a precondition of the smooth evolution of each individual tree.

Today, general systems theory has moved beyond the arena of theoretical controversy into the field of practical decision-making. Operational systems models as diverse as models of urban, military, health, energy, and political systems emerge in profusion. Discerning their mutual relevance calls for a general map, which is offered by the theory of invariant systemic organization, crossing multiple levels in hierarchic sequences. The body of concepts produced by general systems theorists can be of vital service to mankind. They can furnish the core of the conceptual synthesis of the coming age, a core which conserves scientific precision, and combines it with the wide vistas of relationships needed to relate the basic facts of systemic existence to the high reaches of the human intellect. General systems theory is the foundation for systems philosophy.[11] Jointly they give us the skeleton of the conceptual synthesis which we shall have to clothe with flesh before long, if our species is to continue to evolve its civilization on this planet without destroying its order and exhausting its resources.

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