Chapter II

The Roads Not Taken:
Futuristic Lessons for Theorizing Ecological Communication

Given the chaotic mushrooming of efforts broadly studied and advertised under the banner of ecological or environmental communication (EC), and the absence of well-articulated theoretical structures to support them, I am obligated to provide a critical introduction to the lone theoretical work devoted to the topic on hand. That work is *Ecological Communication* (1986)—a slim, but dense, and often unreadable, book—by Nikalas Luhmann, a German social theorist. I hardly need to point out to those involved in EC research that Luhmann's book has at best had a bibliographic presence within the literature, whereas Luhmann's other works have not had even that. Because of this lack of context for both the author and the book, I would like to cover two outstanding points prior to getting to the internal details of the latter. One, I shall introduce the general analytical ethos that informs Luhmann's specific formulations related to EC. Two, and in relation to the above, I shall throw some light on relevant aspects of the work of Gregory Bateson—a thinker that partly overlapped, but mostly preceded and influenced, Luhmann; who was at the heart of the analytical ethos from which Luhmann has drawn his own formulations in the larger part; and, who also wrote about both *ecology* and *communication*.

The broader motive behind my present undertaking is, as the subtitle suggests, to draw futuristic lessons for theorizing ecological communication. I would like to clarify that I am not aiming to make a rational reconstruction of some sort of the past intellectual trajectory of EC in order to validate or regularize its present and future. Instead, I shall only scour over, and briefly characterize, the historical cross-section of the intellectual activity that stands to alert us—specifically via its impress upon Bateson and Luhmann—about how we might or might not want to (re)conceptualize EC from now on. This motive rests on the belief that, even as the potential of Luhmann's theory for EC remains to be debated and realized, Bateson and Luhmann perhaps represent those theoretical trajectories, programs, and even attitudes, that have been neglected by the contemporary practitioner of EC.

1. The Analytical Ethos of Bateson and Luhmann

If a typical critical, cultural, literary, social, environmental, or political theorist of our contemporary times happens to hit upon the works of Gregory Bateson and Nikalas Luhmann, he is likely to find himself in a remarkably alien world. In the first instance, he may attribute this sense of strangeness to *novelty*—especially in the case of Luhmann;[1] in the case of Bateson, he is more likely to attribute it to his loose writing style, outlandish interests, and mixing of unfashionable and otherwise unrelated intellectual strands.[2] In many ways, reading Bateson in the present times is like detouring to a past that is pretty much forgotten in mainstream academic theory—even as it clearly informs the substratum of the information age.[3] Altogether, while Luhmann may appear novel, and Bateson rather eccentrically out-of-fashion, the two are in fact very closely related intellectually—despite the limited internal referencing to Bateson by Luhmann.

Their correlation rests upon the commonality of their inheritances from the techno-scientific and intellectual movements of cybernetics, information theory, communication and communicative systems theory, a so-called "evolutionary vision,"[4] systems theory, and general system theory. These movements developed, both cumulatively and in an overlapping fashion, through the late 1940s, 1950s, 1960s, and even 1970s. While references to them can be encountered in contemporary writings, and there have also been dedicated attempts to keep their principles alive (or to resurrect them), it would be fair to say that these movements have long had their field days: Whereas, instead of commanding a more general visionary sway as they did through the decades of yore, they now remain influential almost entirely within the techno-scientific fields.[5] As introducers to the English editions of Luhmann's works testify to his rising prominence (especially within the intellectual circles of Germany), I stand in doubt as to whether that rise would translate into a general acceptance of the aforementioned discourses and movements.

It would be both overly ambitious and wasteful on my part to try to provide a full-scale survey of the vast and often complicated literatures that came out of these movements: In fact, even a conservative accounting of the sheer terminological battery they generated is apt to constitute a mini-dictionary! This problematic of detail is only aggravated by the peculiarly lexicographical nature of writings produced by the leaders—and even latter-day adherents—of these movements and their affiliated discourses.[6] Hence, I shall restrict myself to providing a brief reflective sketch of strictly those conceptual developments and intellectual inclinations that have directly affected Luhmann's formulations specific to EC. That leaves me with the following subheadings upon which to base my sketch: (A) Focus on *Information*, Automation, and Artificial Intelligence; (B) Systemic and Inter-systemic Thinking; (C) Interdisciplinarity and Meta-frames; and, (D) Fascination with the Universal and the Apolitical.

A. Focus on *Information*, Automation, and Artificial Intelligence

Perhaps the most important development through the 1940s to the 1960s lay in the emergence of increasingly sophisticated and diverse theoretical attempts at the scientific and technological specification and characterization of *information*—and their most dramatic and converging manifestation in *cybernetics*. The efforts came from mechanical and electrical engineering, physics, neurology, mathematics, computing, artificial intelligence, genetics, psychiatry, and chemistry, whereas discoveries and advances in one specialty inspired and consolidated the same in the other specialties. The focus on information went hand-in-hand with the increased fascination with automation. Hence, some scholars traced the roots of this interest in *information* all the way back to James Clerk Maxwell's theoretical analysis of James Watt's governor (1868);[7] others to H. Nyquist's publication on telegraph (1924),[8] and/or R. V. L. Hartley's work on transmission of information (1928).[9]

In announcing the discipline of cybernetics in 1948, Weiner marked the extent of interdisciplinary coordination that had already been underway in the research on *information*.[10] Notably, the non-physical sciences, especially neurosciences, had—for a while by then—been as much a part of this new quest as the physical sciences, engineering, and mathematics. Therefore, the advent of cybernetics was in many ways a pragmatic formalization of the prevailing researches that by default turned *information* into a, if not *the*, universal interface and unit of analysis. James Watson and Francis Crick's 1953 proposal of a three-dimensional double-helix model of the DNA molecule further boosted the general scientific focus on *information* in the life-sciences. The implications of this epistemological choice were manifold, a hint of the extent of whose implications is found, for example, in Jagjit Singh's elucidation of the meaning of *information*. Introducing his 1966 book, *Great Ideas in Information Theory, Language, and Cybernetics*, Singh underlined that

> information, like knowledge in the old proverb, *is* power in the dual sense used here. For it is the information-loaded punch tapes directing the computer in its programmed computation as much as the information-soaked molecules called DNA that make men realize his biological heritage.[11]

In retrospect, however, the stray reader or researcher may need yet another clarification here. That relates to the impression one may get that "information theory" and "communication and communicative systems theory" were mutually distinctive movements or discourses (that also happened to relate to a third, equally distinctive, movement called cybernetics). The fact of the matter is that contributors internal to these developments, especially those that published through the 1940s-1960s, were liable to consider "information theory" and "communication and communicative systems theory" sometimes as sub-movements within cybernetics, sometimes as different names for the same thing (except with slight variations of emphasis), and sometimes even as mutually interchangeable terms that were, in turn, interchangeable with *cybernetics* as well!

For instance, Kenneth M. Sayre viewed these movements as stylistic responses to the technical definition of information that evolved from Hartley's attempt at constructing "a quantitative measure of the relative transmission capacities of electrical communication systems."[12] Sayre pointed out that Claude E. Shannon, Norbert Wiener, and Leon Brillouin adopted the above concept of information but "differed...in their designations of the science in which informational characteristics of communication systems are studied."[13] For example, "Shannon spoke of the mathematical theory of communication; Wiener coined the term 'cybernetics;' and Brillouin chose the title 'information theory'."[14] Sayre, therefore, concluded that the "[c]hoice between 'communication theory' and 'information theory' remains largely a matter of taste [...]."[15]

On the other hand, Giuseppe Longo, a computer programmer, observed a distinction between information theory and communication theory—by relying on Shannon's orientation. Longo dubbed information theory as something that "deals with the mathematical model of communication systems and with the mathematical descriptions of the quantities by means of which the efficiency of those systems is measured."[16] In this definition, information theory—"primarily concerned with transmission problems"—comes up as a case within communication theory and, because of its "statistical...or probabilistic character," is closely tied to (the field of research called) "statistical communication."[17]

These finer points of debate apart, *cybernetics* turned out to be the most popular, catch-all, phrase to capture the general spirit of the new research and intellectual orientations centering around the focus on information; expectedly, it was defined in many closely-related terms depending on the discipline or set of professional objectives of the definer.[18] For example, reflecting a bias toward automation and artificial intelligence, Singh used the term in 1966 "to denote an interdisciplinary inquiry into the nature and physical basis of human intelligence, with the object of reproducing it synthetically."[19] A year later, Charles R. Dechert remarked upon the tendency among American scientists and engineers "working in the theory and applications of self-regulation" to "avoid the term cybernetics, which deals to a considerable degree with isomorphisms among the various types of self-regulating systems."[20] In contrast from those alleged American scientists and engineers, Ludwig Von Bertalanffy, a key proponent of the so-called general system theory, identified cybernetics rather narrowly as "the theory of control mechanisms in technology and nature," viewing cybernetic systems as "a special case" of self-regulating systems.[21] Dechert himself retained the broad meaning—noting that "[i]n the Soviet Union...the term...is used quite broadly"[22]—and divided cybernetics into the following "three large subdivisions":

> [T]heoretical cybernetics which includes mathematical and philosophical problems; the cybernetics of control systems and means which includes the problems of collecting, processing, and output of information, and also the means for electronic automation; [and,] the field of the practical application of the methods and means of cybernetics in all fields of human activity.[23]

Given this broad—yet fairly representative—definition of *cybernetics*, one could legitimately consider cybernetics, information theory, and communication and communicative systems theory as rather overlapping areas that were also closely associated with, affected by, and had resulted in, the advancements in computing and artificial intelligence. In fact, cybernetics drew much of its populist, commercial, and militaristic value from its promises of intelligent machines, robotics, computerization, and (modern or sophisticated) automation. For example, Wiener—unarguably the most media-savvy cybernetician—asserted in 1948 that "the present age is as truly the age of servomechanisms as the nineteenth century was the age of the steam engine or the eighteenth century the age of the clock."[24] This association of cybernetics with modern automation and computerization had only consolidated by the late 1960s and early 1970s, whereas we find both Singh and Dechert reinforcing the difference between the so-called *first* and the *second* industrial revolutions—and crediting cybernetics for it. Pertinently, in his outline of its development, Dechert implicitly identified cybernetics with "control theory," noting that

> [i]n its strict applications, communications and control theory has become a major factor in contemporary technology and lies at the base of the "second industrial revolution." In the "first industrial revolution" prime movers largely replaced human energy while men performed a control function. Under automation, process and production *control* is relegated to servomechanisms while the human operator programs, monitors, and maintains the automated system.[25]

That said, cybernetics' popular identification with automation and computerization culminated in—and as a result of—those techno-scientific research programs and socio-philosophical statements and visions that seriously observed living beings, especially humans, *in terms of* automated machines or computers. For example, in his no-nonsense tract, *You are a Computer: Cybernetics in Everyday Life* (1970), V. H. Brix described the "functioning of the brain" —among other human aspects—"in terms of information, bringing out analogies with the operation of computers."[26] Offering his cybernetic model of analysis, he forbade using "words such as 'freedon', 'loyalty', 'thought' etc. which are largely emotive and are barriers to agreement," and strongly advocated "a completely mechanistic approach."[27] This was because

> mechanisms, meaning the things which we touch, see, and can to some degree predict, are the things which we really do understand, and can conceptualise within our minds. These objective things can be compared, and the results can often be expressed in quantitative fashion so that little room for dispute remains.[28]

It may seem to some sensitive minds from the 21st century, especially in the backdrop of the ilk of Brix, that cybernetics and information and communicative systems theory (erroneously) privileged machines over livings beings by imposing mechanical models of perception and analysis upon the latter. The fact of the matter is that no other allegation would seem more absurd to the mainstream or respectable cybernetician! In fact, the avowed thrust of most leading researchers was on detecting and establishing homologies, analogies, and isomorphisms between the living and the mechanical at the level of their informational make-ups, and in reference to the structures of flows of information across them and the environment. Their underlying aim was to develop a better understanding of the control systems of the living and the mechanical in order to, for example, better address problems in neurophysiology, on one hand, and build smarter machines, on the other. Hence, Wiener's account of his and his colleagues' experimentations on a cat's reflex responses—which they "tried to analyze as we should analyze a mechanical or electrical system exhibiting the same pattern of hunting"—occurs in the same treatise as the following passage (which attributes biological features to the automatic machine):[29]

> [T]he many automata of the present age are coupled to the outside world both for the reception of impressions and for the performance of actions. They contain sense organs, effectors, and the equivalent of a nervous system to integrate the transfer of information from the one to the other. They lend themselves very well to description in physiological terms. It is scarcely a miracle that they can be subsumed under one theory with the mechanisms of physiology.[30]

Evidently, while mechanical models did directly contribute to the conceptual framing of living beings in terms of information, control, and coordination, the opposite was about equally true—within the cybernetic world.

B. Systemic and Inter-Systemic Thinking: Cybernetics, General System Theory, and the Evolutionary Vision

In attending to the close connections among modern automation, computing, and information research, it is possible to overlook the concurrent focus through the 1940s-1970s on *systems* as a topic in its own right. *System* was inherent to cybernetics and information and communicative systems theory both as a theme and as an objective, but it was no less of an obsession in the larger socio-cultural and scientific spheres as well—especially within the Western world. (This was partly because the seeds of these movements were sown in the ferment of the chaotic interwar and postwar years.) "The systems view," Ervin Laszlo remarked in 1972

> is the emerging contemporary view of organized complexity, one step beyond the Newtonian view of organized simplicity, and two steps beyond the classical world views of divinely ordered or imaginatively envisaged complexity.[31]

In light of the above, I could say in retrospect that cybernetics was a systemic response to the broader systemic need for systematic thinking about systems! The virtue of such an alliterative, and tongue-twister of a, definition is that it positions cybernetics accurately in the political terms: as a powerful force *in the midst of* a much larger revolution in systemic epistemologies, world-views, and economic frameworks. Prominent developments through that revolution included the emergence of thermodynamics, compartment theory, set theory, graph theory, net theory, game theory, decision theory, and queuing theory,[32] and related advances in psychiatry, evolutionary theory, and ecology. Cybernetics' peculiar significance amidst the above perhaps had to do with its purposeful linking of the living and the non-living and its potential for practical application. That said, it was clearly neither the first nor the last statement on *systems*, and had emerged as a legitimate field of enquiry and techno-scientific praxis only past Frederick Winslow Taylor's (1856-1917) managerial revolution and the introduction of Henry Ford's (1863-1947) moving assembly line.

While the scientific, technological, and intellectual climates were generally charged with *systemic* thinking, Ludwig Von Bertalanffy and Ervin Laszlo theorized about *system* directly and comprehensively—and on the broadest levels. Von Bertalanffy appears to be the earliest proponent of the *general system theory*—later to be a self-styled *discipline* (on some campuses) dedicated to "the formulation and derivation of those principles which are valid for "systems" in general."[33] Laszlo worked along the same lines as Von Bertalanffy, but was perhaps less text-bookish and exhaustive in that he chose to write about the "systems view" and "systems sciences" rather than rigorously outlining a systematic and inclusive academic theory with the classroom in mind.[34]

In general, the focus on *system* meant: viewing any and all elements or phenomena as *hierarchical*, but *dynamic*, *interrelationships*; rejecting conventional distinctions such as living/non-living, natural/artificial, human/animal, arts/sciences, or biological/physical sciences for their lack of grounding in sound epistemology—embracing, instead, systemic, structural, or informational connections through and across them; and, striving for *general*, but *exact*, analytical frameworks, knowledge claims, and functional mechanisms. In following upon the above, the proponents and adherents of the systems view believed that reason was on their side, their framework was both more useful and efficient than any others, and that theirs was a compassionate research program.[35]

On the last front, for example, Von Bertalanffy distinguished the systems view—but especially his *general* system theory—from even cybernetics, arguing that the latter was merely "an extension rather than a replacement of the mechanistic view and machine theory."[36] But, in general, system theorists of all hues (including cyberneticists) defended themselves from the accusations of reductionism, atomization, and mechanistic thinking on one hand, and vagueness and triviality, on the other—by *rejecting* each of the above elements from their framework. Alternatively, they viewed and promoted themselves as *holists*, whereas Von Bertalanffy called his general system theory a "scientific exploration of 'wholes' and 'wholeness' which, not so long ago, were considered...metaphysical notions transcending the boundaries of science."[37] Apparently, what made the systemic thinkers' explorations scientific without their being mechanistic was their insistence upon the (empirically verifiable) *system* rather than the particle, the atom, *or* some divine or abstract *whole* as the foundational unit of analysis. In the words of Laszlo:

> A systems science can look at a cell or an atom as a system, or it can look at the organ, the organism, the family, the community, the nation, the economy, and the ecology as systems, and it can view even the biosphere as such. A system in one perspective is a subsystem in another. But a systems view always treats systems as integrated wholes of their subsidiary components and never as the mechanistic aggregate of parts in isolable causal relations.[38]

Although a focus on *system* was intended to allow analysts to go beyond the conventional dichotomies or categories, the distinction between the inanimate and the animate remained a matter of contention, and attempts by the theorists to arrive at a resolution have anything but ended. This distinction often cross-referenced with another distinction between the so-called *closed* and *open* systems: Whereas, a system is considered *closed*, to put it in the words of Von Bertalanffy, "if no material enters or leaves it," and *open* "if there is import and export of material."[39] Because the above distinctions continue to remain critical to systems theory's claim to a universal explanatory framework, they need to be examined in some detail and with a measure of clarity. Hence, based upon Von Bertalanffy's highly reliable account, I discuss those distinctions below by dividing the associated debate—predominantly as played out within the Euro-American philosophical paradigm—into four major segments. These segments are only partially chronological; they are mainly intended to provide a pithy, but accurate, cross-section of the debate.

1. First, there had been the intermittent efforts within Western scientific and philosophical paradigms at imposing mechanical images on living beings as explanatory frameworks. Those efforts included the chronologically progressive views of the living being as a: "complicated clockwork" (as proposed by Descartes); "heat engine" (based upon "caloric calculation," and partly inspired by the invention of the steam engine and the development of thermodynamics); chemodynamic machine (that can directly transform "the energy of fuel into effective wok"); "cybernetic machine" (inspired by the inventions of self-regulating machines); and, "molecular" machine (in that "machinelike structures at the molecular level determine the order of enzyme reactions" and "it is a micromachine which transforms or translates the genetic code of DNA of the chromosomes into specific proteins and eventually into a complex organism").[40]

2. The machine model had to be given up partly because it provided no adequate responses to the questions of the organism's "origin," self-regulation in response to "immense" and "arbitrary responses," and mode of self-maintenance (in that the living organism is "composed of fuel spending itself continually and yet maintaining itself").[41] Instead, a systemic model became prominent as it could provide a composite explanation for the similarities and differences between the living and the non-living.

As part of this phase of systemic explanation, there first prevailed the belief within the scientific community that what the physical sciences, including physical chemistry—in kinetics and thermodynamics—studied and addressed were closed systems (that also happened to be inanimate), whereas living systems were *not* closed (and were more accurately addressed by the laws of biological sciences). The Second Law of Thermodynamics stated that closed systems tend to move from a state of order to disorder, measurable as *entropy*, with the projected final outcome on the *cosmic* scale being the so-called heat death of the universe, "when all energy is degraded into evenly distributed heat of low temperature, and the world process comes to a stop."[42] This state of "most probable distribution" of energy, at once the "state of complete disorder" of matter, is also the state of a cosmic thermodynamic equilibrium.[43] On a small scale, then, all closed systems move toward disorder in attempting to attain their own thermodynamic equilibriums.

By contrast, living systems were viewed to differ because of their life-long maintenance of a "steady state" through a constant "inflow and outflow, a building up and breaking down of components"—exemplified on the cellular level in "metabolism."[44] Furthermore, the phenomenon of *equifinality* ensured that "[i]f a steady state is reached in open systems, it is independent of the initial conditions, and determined only by the system parameters, i.e., rates of reaction and transport."[45] For all that, the functioning of living organisms—open systems—was deemed "paradoxical in view of the laws of physics."[46] This paradox was also seen to be reinforced by the "violent contradiction between Lord Kelvin's degradation and Darwin's evolution, between the law of dissipation in physics and the law of evolution in biology."[47] In this scenario, contrary to the projected final outcome of the heat death of the universe for the physical world progressing toward increasing disorder, "the living world shows, in embryonic development and in evolution, a transition towards higher order, heterogeneity, and organization."[48]

3. The development of information and communication engineering and sciences shifted the focus within the physical sciences from *energy* (transfer) to *information* (transfer). This effected a change in the erstwhile understanding of the physical world in terms of energy and matter *alone*, as well as in the self-understanding of the physical sciences. That was because, while "[i]n many cases, the flow of information corresponds to a flow of energy,"

> examples can easily be given where the flow of information is opposite to the flow of energy, or where information is transmitted without a flow of energy or matter.[49]

This focus on *information* led to the following two developments. One, there was the fabrication of the binary system as a measurement of *information* in terms of paired alternative decisions, which by default rendered *information* at once as "a measure of order or of organization"—and hence as *negative* entropy (with entropy being the measure of disorder or random distribution).[50] This rendition of *information* made it possible to interpret non-living and living systems for their informational self-organization, or for how information transferred through, across, and among them (as in biophysics, for example). As such, the distinction between the two was isomorphic to the distinction between closed and open systems, which Von Bertalanffy outlined as under:

> [T]he change of entropy in closed systems is always positive; order is continually destroyed. In open systems, however, we have not only production of entropy due to irreversible processes, but also import of entropy which may well be negative. This is the case in the living organism which imports complex molecules high in free energy. Thus, living systems, maintaining themselves in a steady state, can avoid the increase of entropy, and may even develop towards states of increased order and organization.[51]

The second development was the identification of the so-called *feedback mechanism* as a part of any self-regulating system—and its successful cybernetic reenactment in smart machines, such as thermostats or self-propelled missiles. On the systemic level of information, this appeared to bridge the gap further between the mechanical and the living insofar as "mechanisms of a feedback nature are the base of teleological or purposeful behavior in man-made machines as well as in living organisms, and in social systems."[52]

Notably, Laszlo's "systems view" was based precisely on the idea that feedback mechanism, self-regulation, and evolution cut across the living and the non-living domains—and are, therefore, organizationally similar: "They take in and put out substances or energies; they maintain themselves amidst changing circumstances; and some even grow and evolve into different and more complex shapes."[53] Laszlo coined the term "natural system" for this "highest level of organizational invariance," and defined it as "[a]ny system which does not owe its existence to conscious human planning and execution...including man himself, and many of the mutliperson systems in which he participates."[54] The central features of Laszlo's natural system included the system's: existence as "wholes with irreducible properties;"[55] ability to "maintain themselves in a changing environment,"[56] predisposition to "create themselves in response to the challenge of the environment;"[57] and role as "coordinating interfaces in nature's hierarchy."[58]

Laszlo's nomenclature of "natural system" exhibits clear logical errors in that it includes both "man" and his "multiperson systems"—both of which had been a matter of conscious human planning and execution for a while, and have become even more so since his times. Furthermore, even natural landscapes, including forests, have been consciously managed in many parts of the world for a while now. That said, the retrospective significance of Laszlo's nomenclature does not lie in its accuracy or lack thereof, but in the fact that it was only *one* of the many contentious terminological efforts at talking about *system* at the highest levels. Among other efforts, most would include Wiener et al.'s cybernetics (for its attack on the man/machine distinction); Bateson and Ruesch's communicative system (insofar as it intended to stress the connectivity between the biological, the psychological, and the social by outlining a comprehensive psychiatric framework of communication); Bateson's "ecology of the mind" (for its emphasis on universal interconnectedness based upon *information*); Erich Jantsch et al.'s "evolutionary vision" (for its dismissal of erstwhile distinctions among biological, physical, and social worlds through a composite conception of *evolution*);[59] and, the more recently, Luhmann's communicative system theory (for its sociological reinterpretation of the world based upon a unified distinction of "social" and the "psychological" systems).

4. Von Bertalanffy specific contribution was to assess critically the limitations and contributions of the various systems approaches as well as their claims regarding their own contributions, and generalize those approaches *maximally* in the form of his *general system theory*. Through that process, he underlined the continued presence of the old dichotomy between "mechanical" and "holistic" that those approaches had pointedly set out to resolve (and believed they had resolved)—and reposed the question of theoretical generality as follows:

> [T]here are, within the "systems approach," mechanistic and organismic trends and models, trying to master systems either by "analysis," "linear (including circular) causality," "automata," or else by "wholeness," "interaction," "dynamics" (or what other words may be used to circumscribe the difference). While these models are not mutually exclusive and the same phenomena may even be approached by different models...it can be asked which point of view is the more general and fundamental one.[60]

The distinction between "mechanistic" and "organismic" overlapped with the distinction between "closed" and "open" systems, whereas Von Bertalanffy deemed information theory "highly developed mathematically [but] disappointing in psychology and sociology"[61]—because

> concepts...particularly in the equivalence of information and negative entropy—correspond...to "closed" thermodynamics (thermostatics) rather than irreversible thermodynamics of open systems. [By contrast, the] open-system model is basically nonmechanistic, and transcends not only

> conventional thermodynamics, but also one-way causality as is basic in conventional physical theory [...].[62]

In sum, while the focus on *information* diluted the erstwhile belief in the distinction between closed and open systems, and expanded physics "to include open systems," it did not entirely resolve the issue.[63] In fact, Von Bertalanffy restricted the contribution of the cybernetic approach to a mere "introduction of concepts transcending conventional physics, especially those of information theory," concluding that the "approach retains the Cartesian machine model of the organism, unidirectional causality and closed systems."[64] Furthermore, he considered the open system/feedback mechanism (or cybernetic) dichotomy as "a modern expression of the ancient antithesis of 'process' and 'structure'," which "will eventually have to be resolved dialectically in some new synthesis."[65]

That synthesis seems to have been attempted by Erich Jantsch et al. in the late 1970s and the 1980s in the so-called "evolutionary vision"—in itself a massive expansion and generalization of the "paradigm of self-organization" developed throughout the 1970s within evolutionary theory.[66] Jantsch claimed that the paradigm of self-organization, for being "process-oriented instead of structure-oriented," had led to "a scientifically founded nondualistic view" of evolution in which *evolution* was seen "as an integral aspect" of how dissipative structures organized themselves.[67] Jantsch et al. pushed the frontiers of this framework further in seeking "commonalities...not only between biological and social evolution, but across the entire spectrum from physical/cosmic through biological/sociobiological/ecological to sociocultural evolution."[68] As such, Jantsch et al.'s efforts included, to put it in the words of Elise Boulding, "understandings of the processes of differentiation and complexification of structure within component systems, accompanied by an increase in their information content, in the developing cosmos."[69]

In the main, the evolutionary vision argued that, acting as dissipative structures, systems constantly organize themselves through increasing or cumulative complexification. Notably, the proponents of the vision rejected the realistic possibility of a completely closed system. Instead, they highlighted the inherent fluidity of all phenomena that could be legitimately considered systems, arguing that systems survive not through stabilization but through dynamic interactions with each other and with the environment—within the environment. Peter M. Allen, for example, pointed out that *evolution*

> is the result of this very complex dialogue between stochastic factors (mutation pressure, environment, small numbers) and deterministic factors (selection pressure, steady environment)...[whereas] complexity is limited by stability which, in turn, is limited by the strength of the system-environment coupling.[70]

Jantsch brought *complexity* into the social realm, pointing out that it was produced through systemic "self-transcendence"—i.e., the "creative overcoming of the *status quo*"—but preserved through "self-reference."[71] How systems transcend themselves while also compulsively referring back to themselves during their interactions with their environments would become a major point of theoretical concern for, and contribution by, Luhmann.[72] In fact, Luhmann's reflections on this paradox provide the bedrock for his conceptualization of EC as communication among systems about each other, with each sub-system observing and communicating with all other sub-systems as if they were its *environment*.

The redefinition of *evolution* as a composite socio-natural process of progressive complexification through systematization—or progressive systematization through progressive complexification—and its recommendation as the primary epistemological framework had one important effect: By default, it highlighted the previously neglected factor of (historical) time from the systems-centered theoretical advances. Hereafter emerged a fairly defined image of the evolving world rendered in the systems-theoretical terms: A world of cumulatively complexificating hierarchical systematization. Laszlo captured that image as follows:

> Because the patterns of development in all realms of nature are analogous, evolution appears to drive toward the superposition of system upon system in a continuous hierarchy, traversing the regions of the suborganic, organic, and supraorganic. Organization in nature comes to resemble a complex, multilevel pyramid, with many relatively simple systems at the bottom and a few (and ultimately one) complex system(s) at the top.

> Between these limits all natural systems take intermediate positions; they link the levels below and above them. They are wholes in regard to their parts, and parts with respect to higher-level wholes.[73]

For all that, the evolutionary vision—what Jantsch also called at one place a "general theory of evolution"—was at once a complement to, and a substitute for, Von Bertalanffy's general system theory.[74] It would be interesting to see how Bateson and Luhmann relate to the concept of *evolution*, and what role it plays in their formulations—especially in Luhmann's communicative systems theory of EC.

C. Interdisciplinarity and Meta-Frames: Epistemological Limits; Unificationism; and, Holism

Past the above pages of detail, it is rather redundant to make the observation that *interdisciplinarity* was a passion of record among most enterprising academics active in the aforementioned movements and discourses through the 1940s-1970s. What holds significance, however, is the connection between interdisciplinarity and the related recognition of *framing* as a theme in its own right. The general tendency among the scholars was to push toward higher and higher epistemological levels within their analytical and theoretical frameworks by overcoming disciplinary boundaries through conceptual reframing. Scientific communities in particular tried to resolve their intramural disputes and differences by emphasizing and further developing isomorphisms and similarities—partly in order to turn the fear of bewildering specialized advances into a liberating heuristic experience for all.

The scientists also attempted to bridge the gaps between the natural and social sciences—and were complemented by a drive among the social scientists, especially economists, to apply newer scientific lessons to sociological, political, and cultural analyses. This milieu of interdisciplinarity glorified generalized frames and frameworks. For example, Laszlo's portrayed the "new scientist" as someone who "concentrates on structures on all levels of magnitude and complexity, [...] fits detail into its general framework [, and] discerns relationships and situations, not atomistic facts and events."[75] Laszlo went to argue:

> By this method [the new scientist] can understand a lot more about a great many more things than the rigorous specialist, although his understanding is somewhat more general and approximate. Yet some knowledge of connected complexity is preferable even to a more detailed knowledge of atomized simplicity [...][76]

This spirit of generality was also reflected in the original program of the Society for General Systems Research, which was founded in 1954 as the Society for General Systems Theory "to further the development of theoretical systems which are applicable to more than one of the traditional departments of knowledge."[77] Tellingly, the Society undertook to

> (1) investigate the isomorphy of concepts, laws, and models in various fields, and to help in useful transfers from one field to another; (2) encourage the development of adequate theoretical models in the fields which lack them; (3) minimize the duplication of theoretical effort in different fields; [and,] (4) promote the unity of science through improving communication among specialists.[78]

Likewise, even though Jantsch et al.'s evolutionary vision did not directly comment upon the age-old project of "unity of science," it harbored ambitions that went way beyond that. *Evolution* was made to embody a newer holistic paradigm of transdisciplinary knowledge and sweeping epistemic frames as Erich Jantsch argued that

> principles may be found which unify the description of evolution in two important dimensions: (1) across the hierarchy of evolutionary dynamics from ontogeny through phylogeny to anagenesis (the evolution of new levels of evolutionary dynamics), and (2) across domains of reality from the physical (cosmic) through the biological (sociobiological, ecological) to the sociocultural domain.[79]

Notably, through the overall preeminence of holism and unificationism, there was also the ironical realization that knowledge-systems, no differently than individual observers or experts, *had* boundaries, were limited in terms of what they could accomplish, and were liable to constitute partial, relative, and therefore *complementary*, knowledges. Best captured by Bateson's semi-rueful observation that "there must be a limit beyond which epistemology cannot go," this realization explains part of the drive toward devising epistemic meta-frames—exemplified, for example, in Ruesch and Bateson's concept of metacommunication.[80] An added irony lay in the sense of competition that at least *some* experts betrayed at proving their own (inter)disciplinary frameworks to be the more novel and encompassing than the rest—and hence the more suited for an across-the-board epistemological systematization. Ruesch (and Bateson), for example, proposed to "use one single system"—of *communication*—"for the understanding of the multiple aspects of human behavior."[81] Likewise, general systems theory also differed radically from the Vienna Circle's logical positivism in its approach toward unifying science, whereas both Von Bertalanaffy and Laszlo, the card-carrying systems philosophers, rejected logical positivism because of its unnecessary, counter-intuitive, and epistemologically unsupportable reductionism.[82]

In short, there was enough disunity—and enough underlying efforts to overcome that disunity—among the unificationists! Of particular relevance to our focus here is to consider how these interdisciplinary, holistic, and unificatory drives have affected Luhmann's conceptualization of EC. Whereas, *one* of the two major factors include the recognition of perspectival relativism and the possibility of its resolution through reflexive observation and in hierarchical abstraction. What this factor entailed in principle was the belief that while disciplines and practitioners had unique things to say about the same reality—that was their relativism—they were analytically unifiable through reflexive (re)framing. For, even Ruesh's argument for the epistemological uniformity (and Bateson's subsequent emphasis on the "perception of perception") was prefaced by his observation that the "varied foci of interest are usually watched and studied by different disciplines, all using their own concepts and their separate technical languages."[83] Von Bertalanffy captured the above on an existential level as under:

> [U]ltimate reality is a unity of opposites; any statement holds from a certain viewpoint only, has only relative validity, and must be supplemented by antithetic statements from opposite points of view. ...[E]ven though de-anthropomorphized, knowledge only mirrors certain aspects or facets of reality.[84]

Later on, Luhmann would formulate a more precise framework for explaining how such a unification is attained epistemologically and existentially. He would base his explanation primarily upon the concept of "unity of differences"—a state attainable by sub-systems through implementation of "operational closure" at the inter-systemic level.[85]

The *second* factor to notice in Luhmann in connection with unificationism and holism is the erasure from his version of systems theory any and all references to *spiritual* holism and philosophical unification of East and West, both of which one routinely encountered in the earlier literatures (including that of Bateson's). The implications of this erasure are enormous for the conceptions of ecology, communication, *and* ecological communication—especially if we decide to view them, as we shall, against the backdrop of globalization, spatial and cultural politics of ecology, and international communication.

D. Fascination with the Universal and the Apolitical

Given that advances in science and technology had a very direct effect on the movements under consideration, the centrality of the vision and rhetoric of a neutralistic universalism to them need not come as a major surprise. The general thrust on evolving epistemological and existential interfaces, identifying structural and theoretical isomorphisms, establishing connectivities, and articulating purportedly grandiose frames of reference—such as *evolution*, *systems theory*, *communication*, or even *cybernetics*—only added to the universalistic drive. Furthermore, there were at least three outstanding political reasons behind that universalism. First, there was the painful resolution of the two World Wars, whose effects were particularly pronounced in the earlier decades of these various movements; two, there was the emergence and flowering of the great rivalry between the communist and capitalistic blocs immediately after the Second World War; and, three, there was the factor of de-colonization in certain parts of the world, especially in Asia, which had resulted in a renewed respectability within the Western world toward their intellectual and spiritual traditions and an urge to bridge the gap between the Orient and the Occident.

Generally, thinkers involved within these movements dealt with the aforementioned political backdrop by promoting their intellectual and technoscientific feats as potential harbingers of global harmony. For all that, it is a matter of both entertainment and illumination to reconsider how their epistemological concerns flowed into a sort of political thought within their rhetoric whenever they did. Keeping in view our own contemporary context, we might also choose to view their peculiar universalism as the rationalistic and sanitized underside of an early phase of the post-colonial globalism or globalization. This is the sense that John J. Ford, for example, betrayed rather closely when he called "automation" a "*universal law of development*" in 1967, and fancied about the positive social and ethical implications of cybernetics as follows:

> In the face of thermonuclear reality and an underdeveloped world on the brink of revolution, a "race" of the developed nations to "consume entropy" and thereby foster the development of emerging nations might prove to be what William James called "moral equivalent of war; something heroic that will speak to men as universally as war does, and yet will be compatible with their spiritual selves as war has proved to be incompatible."[86]

For many others, including the ilk of Von Bertalanffy and Laszlo, systemic universalism was probably more of an opposition to reductionism, phenomenal compartmentalization, and professional specialization than anything else. And for all that, the universalism nonetheless implied a positivistic response to the otherwise depressing prospect of a fast massifying world that was also divided, at least in the eyes of the American and European intellectuals, into the two political blocs. Hence, unless they were to end in a "universal atomic devastation," Von Bertalanffy hoped that "the [ideological] differences between West and East probably will...become insignificant because the similarity of material culture in the long run will prove stronger [...]."[87] Likewise, while admitting the difference between the "political paths pursued by the people in the capitalistic societies and those in the socialistic bloc," Brix concluded his tract, *You are a Computer* (1970), with the "hope, ultimately, of some common goal, some rational society in which adaptability to change can take places smoothly without conflict, by sensitive responses to feedback, and through fully mandated diffusion of control."[88]

Still other thinkers, especially those espousing the evolutionary vision, or Bateson's "ecology of the mind," had a much vaster, cosmic idea of universalism—that bypassed the political by stretching the rationalistic, cybernetic, and systemic routes to a superhighway of science amounting to spirituality. This is the strand of scientific intellectuals that also concertedly attempted to bridge the gap between the Orient and the Occident, as also to supplement the-then novel attempts at scientific and observational unification and holism with their philosophical counterparts from South Asian and Sino philosophies, among others. To illustrate, Jantsch underlined that the

> unifying principles of evolution...emphasize the interconnectedness of evolutionary dynamics at all levels, thus also linking man to universal evolution and imparting a deeper sense of meaning to human life. The emergent picture seems to bear out the three-fold path to higher meditation and human self-realization taught by the foremost philosopher of Tibetan Buddhism (Longchenpa, 1976) [...][89]

This strand of universalism is perhaps more memorably reposed in the hypotheses of Gaia, on one hand, and noosphere, on the other.[90] The next chapter shall highlight the logic behind certain traces of this strand as they manifest themselves in Bateson's ruminations.

Notes

[1] One fellow to have been struck by the novelty of Luhmann is Stephen Fuchs. See Fuchs, "A Social Theory of Objectivity," *Beyond the Science Wars: The Missing Discourse about Science and Society*, Ullica Segerstrale (ed.), Suny Series in Science and Society, State University of New York Press: Albany, New York, 2000, pp. 155-177.

[2] Consider, for example, Daniel R. White's reaction to Bateson's work. White, *Postmodern Ecology: Communication, Evolution, and Play*, State University of New York Press: Albany, New York, 1998. (White is a rare cultural and ecological critic engaging with the work of Bateson.)

[3] Accordingly, Peter Harries-Jones candidly admits that "[m]odern environmentalists have generally ignored Bateson." See Harries-Jones, *A Recursive Vision: Ecological Understanding and Gregory Bateson*, University of Toronto Press: Toronto, Buffalo, and London, 1995, p. 4.

[4] See, in particular: Erich Jantsch (ed.), *The Evolutionary Vision: Toward a Unifying Paradigm of Physical, Biological, and Sociocultural Evolution*, AAAS Selected Symposium: 61, Westview Press: Boulder, Colorado, 1981.
[5] An informative, though necessarily selective and unabashedly self-laudatory, record of on-going and past efforts within cybernetics is found on the homepage of the American Society for Cybernetics. Hosted by the George Washington University, that homepage can be accessed on the following URL: http://gwis.ciirc.gwu.edu/~asc. This page also provides links to a range of contemporary journals related to these movements.

Niklas Luhmann's work can be looked at as a comprehensive attempt at resurrecting cybernetics and systems theory as a broad visionary and analytical framework for the contemporary times and beyond. Other—piecemeal and/or derivative—attempts include the following two: Daniel R. White's *Postmodern Ecology: Communication, Evolution, and Play* (1998), and Peter Harries-Jones's *A Recursive Vision: Ecological Understanding and Gregory Bateson* (1995).
[6] Wherefore, authors such as Norbert Wiener, Julian Bigelow, Arturo Rosenblueth, Warren McCulloch, Ross Ashby, Humberto Maturana, John Louis Von Neuman, Heinz Von Foerster, Gordon Pask, Erich Jantsch, Hermann Haken, Kenneth E. Boulding, Stafford Beer, Ervin Laszlo, Ludwig Von Bertalanffy, Gregory Bateson, Niklas Luhmann, and Paul Pangaro have all invested themselves obsessively in introducing newer terms of reference, radically redefining other commonplace terms, and re-fitting those terms into otherwise overlapping terminological and conceptual *systems*. Unsurprisingly, many books written by these authors contain glossaries at the end—and may read like constitutions of some scientological cult!
[7] As Gordon Pask points out, "it is legitimate to envisage the governor as a device which feeds back *information* in order to effect speed control." See *An Approach to Cybernetics*, Hutchinson: London, 1961, p. 12.
[8] See, for example, Robert M. Losee, "A Discipline Independent Definition of Information," *Journal of the American Society for Information Science*, 48 (3) 1997, pp. 254-269.
[9] For instance, Kenneth M. Sayre, "Philosophy and Cybernetics," *Philosophy and Cybernetics*, Essays Delivered to the Philosophic Institute for Artificial Intelligence at the University of Notre Dame, eds. Frederick J. Crosson and Kenneth M. Sayre, The University of Notre Dame Press: Notre Dame & London, 1967, p. 4.
[10] See Norbert Wiener, *Cybernetics Or Control and Communication in the Animal and the Machine*, The M.I.T. Press: Cambridge, Massachusetts, 1948.
[11] Jagjit Singh, *Great Ideas in Information Theory, Language, and Cybernetics*, Dover Publications: New York, 1966, p. vii.
[12] Kenneth M. Sayre, "Philosophy and Cybernetics," *Philosophy and Cybernetics*, Essays Delivered to the Philosophic Institute for Artificial Intelligence at the University of Notre Dame, eds. Frederick J. Crosson and Kenneth M. Sayre, The University of Notre Dame Press: Notre Dame & London, 1967, p. 4.
[13] *Ibid*, p. 13.
[14] *Ibid*.
[15] *Ibid*.

[16] Giuseppe Longo, *Selected Topics in Information Theory*, Courses and Lectures: No. 18. Lectures held at the Department of Automation and Information, September-October, 1969, International Centre for Mechanical Sciences: Udine, 1973, p. 9.
[17] *Ibid*.
[18] Gordon Pask throws light on this definitional diversity:

> At one extreme, there is the original definition, 'the *science* of control and communication in the animal and the machine,' advanced by Norbert Wiener… At the other extreme is Louis Couffignal's proposal, put forward as an expansion in 1956, 'La Cybernetique est l'art d'assurer l'efficacite de l'action.' The gap between *science* and *art* is filled by a continuum of interpretations. Thus, Stafford Beer looks upon cybernetics as the science of proper control within any assembly that is treated as an organic whole. In industry, for example, this could be the science of management. Also, he regards Operations Research, in its widest sense, as the principal experimental method of cybernetics, the science. Ross Ashby, on the other hand, gives emphasis to abstracting a controllable system from the flux of a real world (for abstraction is a prerequisite of talk about control), and he is concerned with the entirely general synthetic operations which can be performed upon the abstract image. He points out that cybernetics is no more restricted to the control of observable assemblies and the abstract systems that correspond with them, than geometry is restricted to describing figures in the Euclidean space which models our environment.

An Approach to Cybernetics, p. 15.
[19] Jagjit Singh, *Great Ideas in Information Theory, Language, and Cybernetics*. Dover Publications: New York, 1966, p. 5.
[20] Chalres R. Dechert, "The Development of Cybernetics," *The Social Impact of Cybernetics*, ed. Chalres R. Dechert, Simon and Schuster: New York, 1967, p. 18.
[21] Ludwig Von Bertalanffy, *General System Theory: Foundations, Development, Applications*, George Braziller: New York, 2001, p. 17. (First published in 1969.) Notably, Gordon Pask's sketch of a cybernetician corroborates Von Bertalanffy's framing of cybernetics as a theory of control mechanisms:

> The cybernetician has a well-specified, though gigantic, field of interest. His object of study is a system, either constructed, or so abstracted from a physical assembly, that it exhibits interaction between the parts, whereby one controls another, unclouded by the physical character of the parts themselves. He manipulates and modifies his systems often using mathematical techniques, but, because in practical affairs cybernetics is most usefully applied to a very large system, he may also build mechanical artifacts to model them. Simply because the particulars are irrelevant, he can legitimately examine such diverse assemblies as genes in a chromosome, the contents of books in a library (with respect to information storage), ideas in brains, government and computing machines (with respect to the learning process).

Pask, *An Approach to Cybernetics*, Hutchinson & Company: London, 1961, pp. 15-16.

[22] Chalres R. Dechert, "The Development of Cybernetics," *The Social Impact of Cybernetics*, p. 18.
[23] *Ibid*, p. 19.
[24] Norbert Wiener, *Cybernetics Or Control and Communication in the Animal and the Machine*, 1961, p. 43.
[25] Chalres R. Dechert, "The Development of Cybernetics," *The Social Impact of Cybernetics*, 1967, pp. 17-18.
[26] V. H. Brix, *You are a Computer: Cybernetics in Everyday Life*, Emerson Books: New York, 1970, p. 3.
[27] *Ibid*, p. 105.
[28] *Ibid*, p. 105.
[29] Wiener, *Cybernetics Or Control and Communication in the Animal and the Machine*, 1961, p. 19.
[30] *Ibid*, p. 43.
[31] Laszlo, Ervin, *The Systems View of the World: The Natural Philosophy of the New Developments in the Sciences*, George Braziller: New York, p. 15.
[32] Ludwig Von Bertalanffy explains these theories in his *General System Theory: Foundations, Development, Applications,* George Braziller: New York, 2001. See especially pp. 20-23. (First published, 1969.)
[33] *Ibid*, p. 32. Von Bertalanffy claims that he first presented the idea of "General System Theory" in 1937. See *ibid*, p. 90.
[34] Other authors that clearly focused on *system* as a theme—within their disciplines or in general—included A. D. Hall & R. E. Fagen, W. Ross Ashby, Stafford Beer, W. Buckley, F. S. Grodin, C. A. McClelland, B. C. Patten, D. Rapoport, and R. Rosen. See: Stafford Beer, "Below the Twilight Arch--A Mythology of Systems," *General Systems*, 5: 1960, pp. 9-20; W. Ross Ashby, "Principles of the Self-Organizing Systems," *Principles of Self-Organization*, eds. H. Von Foerster and G. W. Zopf, Jr., Pergamon Press: New York, 1962; A. D. Hall & R. E. Fagen, "Definitions of Systems," *General Systems*, I: 1956, pp. 18-29; W. Buckley, "Sociology and Modern Systems Theory," Prentice-Hall: Englewood Cliffs, New Jersey, 1967; F. S. Grodin, *Control Theory and Biological Systems*, Columbia University Press: New York, 1963; C. A. McClelland, "Systems and History in International Relations--Some Perspectives for Empirical Research and Theory," *General Systems*, 3: 1958, pp. 221-247; B. C. Patten, "An Introduction to the Cybernetics of the Eco-system: The Tropo-Dynamic Aspect," *Ecology*, 40: 1959, pp. 221-231; D. Rapoport, *Fights, Games, and Debates*, University of Michigan Press: Ann Arbor, Michigan, 1960; R. Rosen, "A Relationship Theory of Biological Systems," *General Systems*, 5: 1960, pp. 29-44.
[35] Hence, such writings as Norbert Wiener's *Human Use of Human Beings: Cybernetics and Society*, Houghton Mifflin: Boston, 1950.
[36] Von Bertalanffy, *General System Theory: Foundations, Development, Applications*, p. 23. Nevertheless, Von Bertalanffy, accepted cybernetics as *one* important component of the general system theory—just as he attempted to show the whole host of other (previously mentioned) system-centered theories and research-programs to be subsidiary parts of the latter.
[37] *Ibid*, p. xx.

[38] Laszlo, pp. 14-15.
[39] Von Bertalanffy, *General System Theory: Foundations, Development, Applications*, p. 121.
[40] *Ibid*, p. 140.
[41] *Ibid*, pp. 140, 141.
[42] *Ibid*, pp. 40-41.
[43] *Ibid*, p. 39.
[44] *Ibid*, p. 39.
[45] *Ibid*, p. 142.
[46] *Ibid*.
[47] *Ibid*, p. 40.
[48] *Ibid*, p. 41.
[49] *Ibid*, p. 42.
[50] *Ibid*.
[51] *Ibid*, p. 41.
[52] *Ibid*, p. 44.
[53] Laszlo, p. 22.
[54] *Ibid*, p. 23.
[55] *Ibid*, p. 27.
[56] *Ibid*, p. 34.
[57] *Ibid*, p. 46.
[58] *Ibid*, p. 67.
[59] Erich Jantsch (ed.), *The Evolutionary Vision: Toward a Unifying Paradigm of Physical, Biological, and Sociocultural Evolution*, 1981.
[60] Von Bertalanffy, *General System Theory: Foundations, Development, Applications*, p. 25.
[61] *Ibid*, p. 23.
[62] *Ibid*, p. 163.
[63] *Ibid*, p. 40.
[64] *Ibid*, p. 163.
[65] *Ibid*.
[66] Erich Jantsch, "Unifying Principles of Evolution," *The Evolutionary Vision: Toward a Unifying Paradigm of Physical, Biological, and Sociocultural Evolution*, p. 84.
[67] *Ibid*.
[68] *Ibid*.
[69] Elise Boulding, "Evolutionary Visions, Sociology, and the Human Life Span," *ibid*, p. 169.
[70] Peter M. Allen, "The Evolutionary Paradigm of Dissipative Structures," *ibid*, p. 50.
[71] Erich Jantsch, "Unifying Principles of Evolution," *ibid*, p. 91.
[72] See especially Niklas Luhmann, "Self-Reference and Rationality," *Social Systems*, Trs. John Bednarz, Jr. & Dirk Baecker, Stanford University Press: Stanford, California, 1995, pp. 437-477. (First published in the German, 1984.)
[73] Laszlo, p. 67.
[74] *Ibid*.
[75] *Ibid*.

[76] *Ibid*.
[77] Von Bertalanffy, *General System Theory: Foundations, Development, Applications*, p. 15.
[78] *Ibid*.
[79] Erich Jantsch, "Unifying Principles of Evolution," *The Evolutionary Vision: Toward a Unifying Paradigm of Physical, Biological, and Sociocultural Evolution*, p. 83.
[80] Gregory Bateson, "Conventions of Communication: Where Validity Depends upon Belief," *Communication: The Social Matrix of Psychiatry*, Jurgen Ruesch and Gregory Bateson, W. W. Norton & Company: New York, 1968, p. 227.
[81] On his and Bateson's behalf, Ruesch went on to assert the validity of their proposal as follows:

> As of today, we believe that communication is the only scientific model which enables us to explain physical, intrapersonal, and cultural aspects of events within one system. By the use of one single system we eliminate the multiplicity of single universes, the multifarious vocabularies, and the controversies which arise because we, the scientists and clinicians, cannot understand each other. To introduce the reader to such a system of explanation in its application to the field of psychiatry the present volume has been written.

Ruesch, "Values, Communication, and Culture: An Introduction," *Communication: The Social Matrix of Psychiatry*, p. 5.
[82] As Von Bartalanffy forcefully argued:

> So far, the unification of science has been seen in the reduction of all sciences to physics, the final resolution of all sciences to physics, the final resolution of all phenomena into physical events. From our point of view, unity of science gains a more realistic aspect. A unitary conception of the world may be based, not upon the possibly futile and certainly farfetched hope finally to reduce all levels of reality to the level of physics, but rather on the isomorphy of laws in different fields.

General System Theory: Foundations, Development, Applications, p. 48.
[83] *Ibid*, p. 4.
[84] *Ibid*, p. 48.
[85] See especially Niklas Luhmann, *Theories of Distinction: Redescribing the Descriptions of Modernity*, ed. William Rasch, trs. Joseph O'Neil, Elliott Schreiber, Kerstin Behnke, and William Whobrey, Stanford University Press: Stanford, California, 2002.
[86] John J. Ford, "Soviet Cybernetics and International Development," *The Social Impact of Cybernetics*, ed. Charles R. Dechert, Simon and Schuster: New York, 1967.
[87] Von Bertalanffy, *General System Theory: Foundations, Development, Applications*, p. 204.
[88] V. H. Brix, *You are a Computer: Cybernetics in Everyday Life,* Emerson Books: New York, 1970, p. 137.
[89] Erich Jantsch, "Unifying Principles of Evolution,"*The Evolutionary Vision: Toward a Unifying Paradigm of Physical, Biological, and Sociocultural Evolution*, p. 112.

[90] For a quick survey of these and related hypotheses, please see *Paul R. Samson and David Pitt* (eds.), *The Biosphere and Noosphere Reader: Global Environment, Society, and Change*, Routledge: London & New York, 1999.