

SYSTEMS METAPHYSICS: A BRIDGE FROM SCIENCE TO RELIGION

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Abstract

‘Systems theory’ is familiar to many as the scientific enterprise that includes the study of chaos, networks, and complex adaptive systems. It is less widely appreciated that the systems research program offers a world view that transcends the individual scientific disciplines. We do not live, as some argue, in a post-metaphysical age, but rather at a time when a new metaphysics is being constructed. This metaphysics is scientific and derives from graph theory, information theory, non-linear dynamics, decision theory, game theory, generalized evolution, and other transdisciplinary theories. These ‘systems’ theories focus on form and process, independent of materiality; they are thus relevant to both the natural and social sciences and even to the humanities and the arts. Concerned more with the complex than the very small or very large, they constitute a metaphysics that is centered in biology, and thus near rather than far from the human scale.

Systems metaphysics forges a unity of science based on what is general instead of what is fundamental; it is thus genuinely about everything. It counters the nihilism of narrow interpretations of science by affirming the link between fact and value and the reality of purpose and freedom in the natural world. It offers scientific knowledge that is individually useful as a source of insight, not merely societally useful as a source of technology. With the new world view that it brings, systems metaphysics contributes to the recovery of cultural coherence. It builds a philosophical bridge between science and religion that is informed by our understanding of living systems. It suggests a secular theodicy in which imperfection is lawful yet perfecting is always possible, and uses this perspective to analyze religions as systems. It provides scientific insights into traditional religious concepts, including those ideas that guide spiritual practice.

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1. *Systems Metaphysics*

1.1 The systems project

The systems project crystallized in the post-World War II period around theories about automata, information, feedback control, open systems, decision-making, games, learning, and other subjects. It consisted of general systems theory, cybernetics, and operations research. Contemporary studies of complexity – of chaos, networks, adaptive systems, etc. – are a ‘renaissance’ of this project. For brevity, the label ‘systems theory’ is used here to refer to the achievements of this entire scientific enterprise. Although, to be precise, one should really speak of systems theories, in the plural, these theories have a common character and reflect a common perspective. They are transdisciplinary, being more abstract and general than specific scientific theories but less abstract and general than mathematics and philosophy. They are components for an ‘exact and scientific metaphysics’ (Bunge, 1973) that is currently being developed but still awaits a full articulation.

‘Metaphysics’ here means an account of the most general features of the world (i.e., it does not refer to an inquiry about God, free will, or the soul). An ‘exact metaphysics’ is one that is mathematical. A ‘scientific metaphysics’ is one that is grounded in, i.e., draws upon and contributes to, the sciences. An exact and scientific metaphysics thus seeks a two-fold truth: it attempts to satisfy both the rational standard of coherence and the empirical standard of correspondence, while being also meaningful and generative. Concerned more with the middle scale than the very small or very large, this metaphysics privileges biology over physics. It reflects the radical (though once traditional) view that it is the general and not the fundamental that is ‘about everything.’ While the current fragmentation of science cannot be remedied by promissory notes – never redeemable – of the in-principle reduction of other sciences to physics, it *can* be remedied by a systems metaphysics that brings new understanding of scientific knowledge.

Unity of science based on systems metaphysics is only a possibility, not yet an actuality, but the systems project is already *the* interdisciplinary movement in the sciences. While integration by reduction can be achieved locally between vertically adjacent fields of science – this is what ‘consilience’ (Wilson, 1998) is about – a truly unitary view of the world requires a different approach, one that accords full ontological status to systems at all scales. Graph theory, information theory, nonlinear dynamics, feedback control, game theory, and the like are the lingua franca of theory in all the sciences. Familiarity with these theories is widespread, but what is still missing is the recognition of their underlying commonality: they organize knowledge around form rather than matter (they are in the tradition of Pythagoras rather than Democritus) and around isomorphism and emergence rather than reduction. They are thus relevant not only to the natural and social sciences but to the humanities and the arts as well.

The potential role of systems theory should not be exaggerated. The systems program is an auxiliary enterprise that complements mainstream science. Universities will never be reorganized along Pythagorean lines and systems categories – order, dynamics, information-processing, morphogenesis, agency, adaptation, etc. – will never supplant the conventional materiality-based organization of scientific knowledge.

Systems theory is too abstract to be more than supplementation. But this supplementation is needed for the continued development of science and for its successful application to human needs. Science now encounters major difficulties arising from the exponential growth of knowledge. Even within the same field scientists often cannot understand one another. There is little integration across scientific disciplines, and virtually none between science and other aspects of culture. Technology steadily advances in power and its applications are uncontrolled.

A systems metaphysics cannot solve these problems but it can contribute to their amelioration: (a) it provides a new way to integrate and understand scientific knowledge; (b) it reveals the deep connection between fact and value; (c) it formulates scientific knowledge that can be personally appropriated. These potential contributions to science and our relation to science open up a new basis for the science-religion dialog.

1.2 Understanding what we know

Systems theory offers a view of the world that is more encompassing than any view provided by physics. From a physics-based ‘theory of everything,’ one would get only a theory about things that physicists study. To our understanding of life and human society and our natural environment, such a TOE would add nothing. Unity of science cannot be gained by learning the fundamentals of physical reality; it can only be based on general principles that apply to all types of systems. By unifying science in this way, systems metaphysics gives us a new understanding of what we already know. One does not need to descend to the quantum level to see the world differently, and the distinctive features of quantum mechanics are largely irrelevant to the middle-scale domain in which we live. Consider instead the implications of simply understanding the world in terms of the categories of (a) matter, energy, information, and utility, (b) structure, function, and history, and (c) the actual and potential. These notions are central to systems thinking (Gerard 1958; Miller 1978; Kauffman 2000). Truly assimilating them would transform our sense of the world.

If matter is viewed in the light of its informational and functional aspects, our conception of materiality is radically altered. To give only one illustration: oxytocin is a hormone having a particular chemical structure. Functionally it is relevant to maternal emotion and possibly other bonding experiences, but its material structure reveals nothing about this significance. What is salient about oxytocin is its external function, not its internal structure, and its function is informational. If one had a notion of materiality that encompassed its functional and informational aspects, one might speak of oxytocin as exemplifying, as it were, a ‘higher type’ of materiality. This kind of thinking is illustrated in anthropology by the idea of Levi-Strauss (1966) that the distinction between ‘the raw’ and ‘the cooked’ parallels the distinction between nature and culture. What is cooked undergoes material transformations whose cultural significance confers a social function on cooked food. Of course, cooking also has a biological function; what is uncooked may be inedible. Functional considerations are usually considered in philosophical analysis to be inessential because they are external, but why should the essential only be internal; why should it not also involve the interactions of an entity with its environment? In the systems view, what something *is* involves both structure and function, and also history. While ‘being a food’ depends on the presence of an organism

of an appropriate species, why should this dependence make ‘being a food’ a non-essential property? What is the difference, after all, between ‘potential food’ versus ‘actual food’ and ‘potential energy’ versus ‘actual (kinetic) energy’? In both cases, the transition from potential to actual is contingent on external factors. At issue here is the distinction, articulated by Galileo and Locke and now central to the reductionist paradigm, between ‘primary’ and ‘secondary’ qualities. This distinction has validity, but it needs to be supplemented by its complementary opposite. If something is defined not only by structure but also by function, and not only by matter-energy, but also by information, hormones are not merely molecules and cooking is not merely molecular reorganization.

The systems view also challenges other scientific orthodoxies. For example, just as it is possible to over-emphasize structure and take the interactions of an entity with its external environment as irrelevant to its being, or over-emphasize function and regard the internal nature of an entity as infinitely plastic, it is also possible to have a “single vision” – to borrow Blake’s (1802) criticism of Newton – that overemphasizes history, and the ideographic (contingent) character of history at the expense of its nomothetic (lawful) character. (One can also have a narrow vision by *underemphasizing* history.) An overemphasis on history is illustrated by the insistence of Gould (1995), Margulis (1998), and other evolutionary theorists that biological evolution exhibits no progress and nothing justifying any vertical (higher vs. lower) ordering of species or other taxons. In the words of Margulis,

“All beings alive today are equally evolved. All have survived over three thousand million years of evolution from common bacterial ancestors. There are no ‘higher’ beings, no ‘lower animals’ ... Even the ‘higher’ primates are not higher. *We Homo sapiens sapiens* and our primate relations are not special, just recent; we are newcomers on the evolutionary stage. Human similarities to other life-forms are far more striking than the differences.”

This is only a partial truth. It privileges history over structure and function, the contingent over the lawful, and similarity over difference. The historical view of life as a branching tree (or bush) is a great achievement of evolutionary theory, and it is true that the genetics and biochemistry of all forms of life show overwhelming similarity. The human genome is not very different from the genomes of single-celled organisms, and very close to that of our primate relatives. But if ‘higher’ means more complex, autonomous, potent, extensively and diversely interacting, sustained by greater energy throughput, and capable of more refined levels of information processing, can it be denied that, structurally and functionally, single-celled eukaryotic organisms are ‘higher’ than prokaryotic bacteria, that animals having nervous systems are higher than animals which do not, and that human beings are higher than other primates? Is the human species which creates and lives in the informational realm of culture, which theorizes about the origins of the universe, which manipulates massive amounts of energy and minute specimens of matter, and which alters its environment on a planetary scale, not ‘higher’ than a bacterial species?

Overemphasizing history is often associated with the denial of ‘essences,’ i.e., with the nominalist as opposed to the realist philosophical position. If ‘essence’ means something fixed and unitary, then historicity and multiplicity do indeed imply that there are no essences. But if essence just means deep as opposed to surface structure, then diachronic change and heterogeneity do not invalidate the idea of essence. A species genotype is an essence. Species evolve, yes; they are instantiated in actual populations, yes; but within-species and temporal genomic variation do not negate the fact of between-species variation. Essences can be fuzzy rather than crisp (and fuzzy sets and relations are important components of systems theory). Structure is the residue of history. When structure is differentiated into a relatively fixed homogeneous core and a relatively variable heterogeneous periphery, when this core supplies the algorithmic information for the whole structure, one can legitimately speak of essence. Arguments against essences are ideological, not scientific.

‘Progress’ does not mean replacement that is monotonic or irreversible. It does not imply a sequence of levels free of ambiguity. It means the incessant emergence of ever more complex, autonomous, potent, and interacting forms, having new capacities to utilize matter, energy and information. ‘Progress’ in this sense is undeniably an aspect of evolution. While the specific character of these forms is contingent, since they first arise through mutation and other random processes, their general character is lawful, since there are many paths to the order needed by organisms, and this order exists in the realm of the possible before it is attained in the realm of the actual. As Wright (2000) argues, while the evolution of particular species having intelligence was not preordained, the emergence of intelligence per se probably *was* implicit in the evolutionary process (disregarding the possibility of a life-extinguishing global catastrophe). Complex forms when they arise do not supplant simpler forms but supplement them, and while there is no one-dimensional scale of being that is sequentially traversed in evolutionary history, the distinction between higher and lower forms is an obvious and necessary part of any understanding of life.

The tendency in certain expositions of science to overemphasize randomness or misconstrue its significance needs to be corrected. If, for example, a random collision of two gas molecules causes one to occupy a higher energy state, one could say that this state was randomly produced, but the availability of an unfilled higher energy level pre-exists the random event. The possible, not only the actual, is real, especially the “adjacent possible” (Kauffman 2003), which might instead be called the ‘potential,’ since the facilitating environmental conditions (here, the temperature of the gas) make the event more than merely possible. Another illustration of this point: if a box containing two initially separated bar magnets is shaken, the magnets will accidentally meet and stick together. One could say that the resulting magnet pair arose randomly, but this account would be so incomplete as to distort the truth. It would ignore the fact that the stuck-together magnets form a lower-energy and thus more stable structure. Disorder (here, random shaking) actualizes order. Prigogine and coworkers (Nicolis & Prigogine 1977) have promoted this idea – “order through fluctuations” – in the realm of non-linear dynamics and open systems far from equilibrium.

Evolution is commonly explained in terms of random variation and specific selection plus heritability, but this explanation is incomplete. It is only functional-historical; it largely ignores structure and assumes in effect a limitless internal plasticity. Yet the phenomenon of convergent evolution, for example, shows that variation and selection do not fully account for the outcomes of evolution. Insistence on the importance of structure was recognized long ago by Whyte (1965) and has been argued extensively by Kauffman (1993) in his “order for free” ideas. Of course, a structural component – the necessary third aspect of the theory – is now included in the neo-Darwinian synthesis, the work of Mendel and Weismann having been vastly augmented by the discoveries of molecular biology. If the structural component is given its full due, the significance of random variation appears in a new light. It is chance joined to necessity (Monod 1972) that creates new order, and necessity means not only selection but structural and dynamic stability. Random variation is a mechanism integral to open-ended evolutionary search, and this search is over a space of pre-existing possibilities, some of which are favored energetically or dynamically (Bronowski 1970). The overemphasis on randomness in some popular descriptions of evolution seems ideologically motivated: a random universe is a meaningless one, and some scientists, feeling themselves still locked in a struggle with religion, delight in the assertion of meaninglessness. Other scientists indulge in the opposite error of assuming total determinism; this also implies meaninglessness, with all due respect to Spinoza’s heroic efforts to find meaning in such a world. But the fact of the matter is that the world is neither totally random nor totally determined, and the possibility of meaning arises precisely because of this. Recognition of this fact is salient in systems theory, for example in ideas (e.g., Langton 1992) about the significance of “the edge of chaos” (although chaos is not randomness).

1.3 Fact and value

A systems perspective also challenges the venerable separation of fact and value. Between the two, under the aspect of difference, there is indeed a sharp distinction and thus “perfect continence,” to use the expressive phrase of Spencer-Brown (1969), but under the aspect of similarity, the two interact in a complex way that is not at all sterile. To use a visual metaphor from nonlinear dynamics, one might say that while fact and value are different domains of discourse, the two domains are ‘strange attractors’ whose basins of attraction (spheres of influence) interpenetrate in complex ways.

Systems metaphysics brings fact and value into close relation. One way that it does so is via components that are both descriptive and normative. For example, decision theory and game theory are descriptive theories about the ways that rational agents act in situations of risk, uncertainty, and competition/cooperation, but they are also normative theories about how agents *should* act in such situations. These theories provide a language in which complex questions about value, and even ethics, can be clarified by being posed exactly. Another example is the Theory of Social Choice (Blair and Pollak 1983), which derives from Arrow’s finding of the impossibility of achieving rationality, equality, and decisiveness in certain voting or multiple-attribute decision-making situations. Arrow’s result is embodied in a descriptive theory that also has normative implications for social decision-making procedures.

Being centered in biology rather than physics, systems metaphysics situates itself squarely in that realm in which issues of value arise explicitly. In the phenomenon of life, value emerges in a world of fact. Values have causal powers, and the preconditions and consequences of this emergence are proper scientific issues. That is: a 'living system' is a system that has 'interests' (Kauffman 2003). The notion of 'interests' is addressed scientifically by 'utility,' the central concept of decision theory and game theory. Fitness is a specific biological type of utility, namely the 'interest' of leaving offspring. Living systems would be incomprehensible without the idea of fitness, and from an evolutionary perspective, fitness defines the ground of value. Yet reproduction is not actually where value first emerges. Jonas (1966) philosophically and Kauffman scientifically argue for the priority of metabolism, or more abstractly, autopoiesis, i.e., the self-making and self-maintenance of certain open systems far from equilibrium. By satisfying the dynamic and thermodynamic conditions for the persistence of form despite and in fact precisely *via* the flux of substance, being is asserted and value is realized. Beyond the values of self-maintenance and reproduction, there are other values. There is an ensemble, perhaps a hierarchy, of types of value or utility, just as form can be conceived as the bottom level of a hierarchy of information, which includes catalytic, genomic, hormonal, neural, and other types of information. ('Value' and 'utility' are related but not equivalent, but it would go too far afield to distinguish here between them.)

Associated with utility is the notion of 'purpose,' also related to the idea of 'norm.' A norm is exemplified by a set-point that specifies the equilibrium state of a feedback system. (In general, though, equilibrium states of dynamic systems are not norms, since attractors of dynamic systems are specified implicitly and non-locally.) Norms make sense in terms of the utility that they secure, and to Rosenblueth, Wiener, and Bigelow (1943), 'purposefulness' was thus explained by negative feedback. This is a satisfactory account of only one type of purposefulness, but other control mechanisms also exist, e.g., the feedforward regulation described by Ashby (1976). Purpose is also implicit in decision theory and game theory – utility being that which rational agents try to secure or maximize. Genetic algorithms, which operationalize a systems theoretic 'generalized evolution,' provide a mathematical treatment of purpose in the context of optimization. One might construct a hierarchy of purposefulness, analogous to the hierarchies of information and utility already mentioned. Feedback and feedforward control might be the simplest types of purposefulness at the bottom of this hierarchy, but these would be inadequate to describe purposefulness at the human level, as Jonas (1966) has argued. Purposefulness is thus the subject of several systems theories, and well within the realm of science. This was not always so. When vitalists argued that the ideas of Newtonian mechanics were inadequate to account for purpose, they were right, although their own explanations of purpose were scientifically vacuous.

One might speak even of 'freedom.' Jonas suggests that 'freedom' first appears in living systems in the phenomenon of metabolism or autopoiesis. In the sub-organismic world, being requires a union of specific matter with form, but in organisms form becomes liberated from specific matter, and identity, i.e., essence, comes to inhere in form itself. (Here 'form' isn't only static but includes dynamic process.) Form must still be materially instantiated, so organisms continually produce themselves from the flux of matter-energy that passes through them. But in freedom from a fixed material basis, life

becomes completely dependent on this flux, so freedom, in this sense, comes at the price of vulnerability. Living systems gain and indeed require a mode of being that is active rather than passive, both internally and externally (active self-producing requires the selective ingestion of 'food'). With the acquisition of the power of locomotion, which occurs even in single-celled organisms, freedom from a fixed environment is achieved, and the powers of the organism are augmented. One might speak further of freedom made possible by the capacity to take in from the environment and process, not only matter-energy, but information. Freedom is relative, not absolute, but the concept is applicable, though a more modest terminology might instead speak of living systems as 'autonomous.' One can imagine a hierarchy of different types of freedom or autonomy, like the hierarchies of information, utility, and purpose mentioned above. These hierarchies are linked, and a framework of this sort cast in the language of 'energies' is proposed in the philosophical-religious writings of Bennett (1961). Bennett (1956) also suggests a related tripartite classification of systems: the autonomic (organismic), the *hyponomic* (sub-organismic, the micro realm of matter-energy), and the *hypernomic* (cosmological, the macro realm of matter-energy). Roughly speaking, matter is salient in the hyponomic realm; energy is salient in the hypernomic realm; and information is salient in the autonomic realm. From a cosmological perspective, the hypernomic is active, the hyponomic is passive, and the autonomic reconciles.

Systems theory not only helps us think in new ways about familiar facts, and counters the narrowness of received opinion, but may stimulate new explorations and discoveries. Given that the category of utility augments those of matter, energy, and information, one wants to go further. Matter, energy, information, (norm,) utility, ...what? Matter and energy carry information; information carries utility; what might utility carry? If matter-energy is adequate for the material realm, and information spans the material and the living realms but is more visible in the latter, and utility is distinct to the realm of the living, are there further realms and, if so, what categories are basic to them? There is at least one obvious other realm: just as life emerges from matter, mind emerges from life, so one might ask: what new scientific category will be central to some new scientific theory that helps us to understand mind not merely as information processing but as subjective experience? Despite major advances in cognitive science, what science has to say about this question is meager. Midgley (1992) offers an intriguing speculation linking utility and subjective experience: consciousness might be an evolutionary emergent that enables agents to deal with collisions of values.

The possibility of new scientific categories yet to be discovered is not an idle reverie. Theories of matter, of the 'stuff' of the universe, go back very far – to the Greek atomists at least. Although ideas about energy may have been implicit in early philosophy or pre-scientific thought, only with the development of thermodynamics in the 19th century did the notion of energy emerge clearly. Until the mid-20th century, there was no formal concept of information in the natural sciences or of utility in the biological and social sciences. In information theory and game and decision theories, there now exist exact and scientific notions of information and utility. It is hard to imagine not having these ideas at our disposal, but it is only about 50 years ago that they first became available. Surely there will be other general ideas which future theories will formalize (make exact) and operationalize (make scientific). What will they be?

Value is central to the humanities and the arts, and systems theory connects science to these domains. This is possible because systems ideas apply not only to concrete systems but also to abstracted and conceptual systems, i.e., to systems abstracted from or not even grounded in material reality. Systems theories have the broad scope inherent to mathematics, but being less abstract than mathematics, they address themes that are ubiquitous in human experience, such as order and disorder, dynamics, representation, communication, differentiation and integration, and conflict. Connections to the arts and humanities have been made in various ways. Ideas of entropy, information, and order have been applied to communication and form in the arts (Moles, 1966; Arnheim, 1971). Ideas from nonlinear dynamics have been used in literary studies (Hayles, 1990). Computational approaches to art have been pursued; for example, evolutionary algorithms have generated visual and musical forms. Advances in artificial intelligence and artificial life have enhanced animation and special effects in the film industry.

This only briefly samples connections between systems theory and the arts and humanities. Connections go deeper than diverse borrowings and influences. Efforts to develop a general theory of systems have been paralleled by similar aspirations in the humanities. Modern social and literary ‘critical theory’ (Calhoun 1995; Culler 2000) and the movements of structuralism (Caws 1998) and semiotics (Hervey 1982) represent comparable efforts to achieve coherence in the social sciences, humanities, and arts. Sometimes referred to simply as ‘theory,’ this project seeks to occupy an intermediate niche between the abstract fields of linguistics and philosophy and concrete fields such as literature, political theory, psychoanalysis, and feminism. Resemblance to the niche that exact and scientific metaphysics seeks to occupy is plain: linguistics plays the role of mathematics as the means by which the world is modeled; the fields of literature, etc., play the role of the different scientific disciplines to which transdisciplinary theory is applied. The two projects – systems theory in the sciences and ‘theory’ in the humanities and ‘human sciences’ – have more in common than analogous placement of their epistemological niches. The structuralism of Piaget (1970) overlaps considerably with systems theory, and information theory is an important component of semiotics.

In both systems theory and structuralism/semiotics, there is a pervasive abstraction. There is the same flirtation with the denial of objective reality and the affirmation of the arbitrariness of models; i.e., the abandonment of ontology in favor of the exclusive concern with epistemology, as if one could have one without the other. The ‘constructivist’ position is widely held within the systems community; Ashby (1976), who stressed the ‘relativity’ of models, was perhaps in this camp. Both movements share Spinoza as a ‘patron saint’ philosopher. But there is at least one major difference between the two: critical theory and postmodern Theory are highly political. While one can no doubt find in systems theory some ideological presuppositions and agendas, they are less salient than the hegemony of feminism, Marxism, and other ideologies in post-modern thought. This crucial difference makes a productive interaction between the systems theory and post-modernism unlikely, although interaction continues. The shift from structuralism and semiotics to deconstruction has been a shift in the direction of skepticism, nihilism, and obscurity; this limits the fruitfulness of the interaction.

1.4 Personal knowledge

“The ancient desire was surely a quite different one. It was a desire for kinds of explanation that are both much wider and more immediate.” - Midgley (1992)

“Very general metaphysical views ... are not just inert factual propositions which we might accept without altering our attitudes or policies. They speak to our imaginations in a way that changes our world-pictures. They affect our symbolism. They reshape the framework of our thought. They shift our mental postures. They affect that whole vital central area of human life which connects thought, feeling and action. Though they are not themselves value-judgments, they do much to determine our value-judgments.” - Midgley (1992)

Systems theory offers a type of scientific knowledge that can be appropriated by individuals as “personal knowledge.” This phrase derives from Michael Polanyi (1958) who observed that the personal aspects of scientific knowledge are often ignored by philosophers and historians of science, since science for them is quintessentially a collective enterprise. While scientific knowledge is necessarily personalized to a degree by working scientists, this is rarely true for scientific knowledge possessed by people in general. Except where such knowledge touches upon a person’s work or hobbies or upon the education of children, it is received as news from a distant domain, as intellectual stimulation or as a harbinger of economic or medical advances, but in no way as personally meaningful. In the discovery of research and its application in technology, scientific knowledge is societal. It is the basis of economic activity and it plays a cultural role. It is too specialized, however, to be personal. It is isolated from other sources of human knowledge: from religion, literature and the arts, and politics. While science is done by individuals, the knowledge it produces is not used by individuals, except for the professionals who do research or develop technology.

A major reason for this is that knowledge is specialized, and thus is usable only by specialists. Moreover, it is specialized in a particular way: it is materially-organized, that is, scientific knowledge is associated with different types of matter, and most forms of materiality occur in domains distant from ordinary human life. We have no direct access to the stars, to the molecules in our body, to the crustal plates of the earth; we do not interact with clouds. Knowledge about stars, molecules, crustal plates, and clouds cannot be personal. By contrast, systems knowledge is about form and process in general, and everything that we have personal contact with exemplifies one or more archetypal patterns. We have access, not only intellectually but also experientially, to order and disorder, variety and constraint, predictability and unpredictability, complexity, morphogenesis, goal seeking and adaptation, competition and cooperation, system formation, and so on.

Systems knowledge is thus closer and more accessible to us in one way, but it is more distant from us in another: its abstraction makes it unfamiliar and difficult. But imagine if in our schooling, we were initiated into these ideas and trained in their use, not as an alternative to standard science, but as a supplement to it. Perhaps we might then be able to perceive, in our interactions with one another, with the natural world, and even internally within ourselves, the archetypes of networks, variety and constraint, openness

and closedness, feedback, differentiation and integration, hierarchical order, competition and cooperation, etc. Systems knowledge could then become personal knowledge.

The concrete facts of science are fascinating, but have no direct usefulness for us. The abstract principles of systems theory are no less interesting to those with a taste for abstraction, but *do* have implications and utility. Indeed, we might pose the following question to our educators.

Which is it actually more important to learn:

- that what explains the world are its fundamentals, e.g., superstrings – or – *that what explains the world are its most general features, e.g., order and distinction;*
- that atoms are made up of protons, neutrons, and electrons, and protons and neutrons are made of quarks – or – *that all things are both wholes and parts and that wholeness and partness are always in tension;*
- that weather is produced by masses of air at different pressures and temperatures in complicated interactions with one another – or – *that unpredictability in phenomena can be due to random external perturbations or deterministic internal chaoticity;*
- that the excess phosphates dumped into lakes cause eutrophication – or – *that all systems pollute, i.e., excrete disorder into their environment, and that these waste products can be neutralized only by their assimilation in cycles on a larger scale;*
- that genetic information is carried in DNA or RNA by specific nucleotide sequences of adenine, thymine/uracil, guanine, and cytosine – or – *that information is coded in patterns of matter and/or energy;*
- that hanging, swinging, and dimpled chads can mess up elections – or – *that the instantiation of information in patterns of matter or energy is never functionally perfect;*
- that viruses inject their DNA or RNA into cells and by doing so take over cellular metabolism – or – *that the distillation of an informational domain distinct from its matter-energy base opens up the possibility of parasitism;*
- that bacteria inoculated into a nutritive medium grow exponentially but eventually level off at some population size – or – *that growth in many systems (biological, social, technological, etc.) is dominated first by positive and then by negative feedback, which usually produces an S-shaped growth curve;*
- that volcanoes and earthquakes are the result of collisions of large tectonic plates moving on the surface of the earth – or – *that open systems far from equilibrium spontaneously reach critical states where sudden changes occur unpredictably at many scales;*

- that the evolutionary record shows massive biological extinctions in various specific geological periods – or – *that punctuated equilibria can occur even from internal causes in a dynamic system at the edge of chaos*;
- that it is difficult to prevent overgrazing in land held in common – or – *that there are many situations in which individual rationality produces collective irrationality*;
- that suppression of fires build up a large flammable base which can fuel more severe fires, and the overuse of antibiotics leads to the evolution of resistant strains – or – *that interventions in complex systems often produce counter-intuitive effects, sometimes even exacerbating the very conditions intended to be alleviated*;
- that medicine X designed to counter disease Y has unfortunate ‘side effects’ on organ Z – or – *that one can never do just one thing and ‘side effects’ are never avoidable*.

Many more such paired alternatives could be cited.

The study of scientific *fact* contributes to the growth of knowledge, but the study of scientific *principle* contributes to the development of understanding. There can be power in knowing the fundamental and there can be wisdom in understanding the universal. There is more than enough power in the world, but not enough wisdom.

Imagine one of the above ideas – that individual rationality can lead to collective irrationality (the prisoner’s dilemma) – effectively taught in all elementary and high schools. Imagine as a consequence that in a new generation this archetypal non-zero sum game was easily and rapidly recognized. Imagine that instead of the fruitless tension between the injunctions of “looking out for number 1” and “doing what society says is right,” there was a real appreciation of dilemmas of collective action; that instead of the habit of blame in conflict there was an understanding of how the structure of situations binds the actors involved; that instead of the naive belief in preordained harmony between individual self-interest and the common good there was the more sophisticated realization that in some situations there is such harmony but in other situations there isn’t. Would this not be a significant contribution to the moral education of our children?

Imagine that a second systems idea – the limits of exponential growth, which is summarized in the S-shaped growth curve – was effectively taught in all elementary and high schools. Is it not likely that this would provide some of the public understanding and support that is needed to confront and respond to the ecological and environmental challenges that now threaten the planet? Would this not be a significant contribution to the welfare of our children, and of future generations?

Multiply this many-fold with numerous other systems principles. Deepen this with the understanding that these are the general archetypes that govern both the harmony and the disharmony of the world. Provide practice in the application of this understanding to both ourselves and the world, to both the subjective and objective realms. Would not an exact and scientific metaphysics contribute enormously to real education?

2. A Bridge from Science to Religion

Systems metaphysics has implications for the science-religion dialog: (a) it offers a ‘secular theodicy’; (b) it suggests grounds for dialog beyond the usual ideas drawn from physics; (c) it points to the quasi-scientific character of some religious practice.

2.1 Secular theodicy

“Perfection is not of this world.” - Ali (founder of Shi’a Islam)

“It is impossible for a man not to be part of Nature and not to undergo changes other than those which can be understood solely through his own nature and of which he is the adequate cause.” - Spinoza, *Ethics*

Systems theory offers an ontology of problems that is a ‘theodicy,’ but a secular one (Zwick 1984, 1995, 2000). Traditionally, theodicy is the reconciling of divine justice and divine power with the reality of evil, the word ‘evil’ being used not narrowly as an epithet for wrongful human action (‘moral evil’), but broadly to include suffering, decay, imperfection, and death (‘natural evil’). It is one of the major attractions of a scientific metaphysics that it offers an account of the origins and nature of evil, cast in general terms and linked to scientific understanding.

Literally, of course, a ‘secular theodicy’ – one expressed scientifically – is a contradiction in terms, as reference to divinity has long been abandoned in scientific discourse. Yet if we no longer feel a religious contradiction in the existence of evil in a divinely-created order, there still is a need for explanation and consolation, which are also functions of theodicy. Systems ideas can contribute to an explanation of human suffering in terms of the universal character, the ‘lawfulness’ as it were, of the difficulties that afflict systems.

In a reductionist metaphysics, a theodicy is impossible. The problem of evil is divided into smaller unconnected problems, and at the level of elementary particles, it disappears. Evil is not a well-posed problem in physics and from its fundamental point of view is illusion. The systems view “saves the phenomena” and provides a general explanation of evil, i.e., of precariousness, dysfunction, and suffering. Central to this view is the recognition that constraint is a property of the cosmos on all levels. In Kabbalistic metaphysics, constraint is ‘severity,’ which is intrinsic to – indeed the price of – existence. Scholem (1991) writes in “Sitra Ahra: Good and Evil in the Kabbalah”,

“...But the act of *tsimtsum* itself, in which God limits Himself, requires the establishment of the power of *Din*, which is a force of limitation and restriction.

Thus the root of evil ultimately lies in the very nature of Creation itself, in which the harmony of the Infinite cannot, by definition, persist; because of its nature as Creation – i.e., as other than Godhead – an element of imbalance, defectiveness, and darkness must enter into every restricted existence, however sublime it may be. It is precisely the rigorously theistic tendency of Lurianic Kabbalah that requires evil as a factor necessarily inherent in Creation per se, without which Creation would necessarily lose its separate existence and return to being absorbed in the Infinite.”

It is surely a stretch to give mathematical interpretations to Kabbalist ideas, but, encouraged by Boulding's injunction that systems thinkers should not be afraid to appear ridiculous and by his personal example of boldness, consider the following: *tsimtsum*, in terms of the set-theoretic definition of constraint, is the necessary diminution of the possible in the actual: there is no order, i.e., coherent existence, without constraint, without the exclusion of possible states. Or, in terms of the system-environment distinction, *tsimtsum* is incompleteness, the 'constriction' or limitedness of a system within its context. Every system exists within some larger environment. This is to apply Lurianic ideas to individual systems, not to creation as a whole.

Constraint is opposed by variety, which is not inherently different from disorder, which is another source of imperfection. So all systems are subject to the dual and conflicting imperatives of constraint and variety, order and disorder. While it is possible to reconcile these imperatives, each of which in isolation causes evil, reconciliation cannot be guaranteed. A systems theodicy declares the universality – really, ubiquity – of this and many other tensions within systems: incompleteness vs. inconsistency, rigidity vs. flexibility, openness vs. closedness, autonomy vs. interdependence, etc., yet does not assert the impossibility of balancing these contrary tendencies and needs. It locates imperfection in the very structure of existence, but it does not preclude it being ameliorated – at least temporarily and locally.

If a systems theodicy provides a 'defense of God' by explaining evil and suffering as inevitable components in the natural order, it also provides a 'defense of Man' against the charge, made by western and eastern religious doctrines, that evil and suffering is fundamentally of human origin, due to action or ignorance. This accusation blames the victim. Although some victims are blameworthy and even victims have responsibilities, what original sin there is in humanity only exemplifies the more general sin of origin that is common to all being, the imperfection that afflicts all creation that has its basic source in finitude. 'Sin' – in Hebrew, 'missing the mark' – always comes with origin, i.e., with existence, reflecting the necessary incompleteness and inconsistency of all things. To give a more balanced view, though, finitude is also original virtue, a manifestation of the good that also blesses existence.

Imperfection is not merely the inadequate instantiation of form by substance. It is not only, as Plato held, that matter is recalcitrant and embodies form only approximately. Form is recalcitrant as well; *both* are afflicted with the consequences of finitude. It was once believed that perfection and simplicity of form were reflections of the divine, but there were always counter-indications. The Pythagoreans suppressed their discovery of the irrationals. Kepler was forced to sacrifice the beauty of his Platonic solids model of the solar system, as well as the perfection of the circle, in favor of the mathematically inelegant ellipse, which so distressed Kepler that he referred to it as a 'cartful of dung' (Koestler 1959). In our own time, a vision of a perfectly orderly world of form was sought by Whitehead and Russell in their *Principia Mathematica* (1910), but this vision was decisively undermined by Gödel's theorem, the implications of which are still unfolding. It is commonplace now to note imperfections in the world of form and incapacities of human reason. Game theory, the Arrow Impossibility Theorem, and the theory of computational complexity reveal limits to order and rationality. Cybernetics

shows that signal and noise, representation and illusion, are not intrinsically distinguishable. Chaos demonstrates that complexity is implicit in simplicity and severs the connection between determinism and predictability. If the forms are in the heavens, there is strife there as well.

This is not cause for alienation. We are at home in the universe not only because the order within is isomorphic to the order without, as Hermetic philosophy asserted, but also because the *disorder* within is isomorphic to the disorder without. As limited wholes, we are simulacrum of the larger whole. Our flaws are lawful; they echo the flaws of the cosmos, and in this isomorphisms of negative qualities, there is also meaning. Of course, strictly speaking, the very idea of ‘flaw’ (‘evil’) is necessarily relative to entities with ‘interests,’ i.e., living systems, but this does not make the ‘imperfection’ of the cosmos a ‘secondary’ quality that can be dismissed as inessential.

To use the terminology of theodicy, what is being discussed here is ‘metaphysical evil.’ Leibniz held that metaphysical evil was the basis of both ‘natural evil’ and ‘moral evil’ (Neiman, 2002), and the Kabbalist and dialectical position advocated here supports this view. More precisely, metaphysical evil encompasses natural evil, and natural evil encompasses moral evil. Metaphysical evil is the most general conception, and includes natural evil as concrete instantiation. Natural evil includes moral evil because humanity is part of the natural order. Both of these inclusions reflect the aspect of isomorphism, i.e., similarity, but under the aspect of difference, specifically emergence, moral evil is also a special case, because humans have unique capacities and thus also responsibilities. Human beings are both part of the natural order *and* unique, a dual affirmation well articulated by Jonas (1966).

Referring moral evil back to natural evil, and natural evil back to metaphysical evil, is, one must admit, a kind of ‘reductionism’ (though it might be called ‘expansionism’ or ‘upwards reductionism’). It represents, as all reductionisms do, a dissatisfaction with multiplicity. But tracing evil back to its metaphysical origins does not allay this dissatisfaction, because multiplicity rules in the heavens as well. Evils have not one but many metaphysical essences, so what is really gained by a metaphysical account over an ethicist’s newspaper column or a radical’s manifesto? Two answers can be given to this question. First: essences are deeper (higher in the ‘upwards’ metaphor) than appearances, so it behooves us to grasp them. Second: one can in fact give a unitary account of metaphysical evil. Lurianic Kabbalah offers such a view. Related to this view is the quote from Spinoza that opens this section: metaphysical evil has its ultimate source in incompleteness, in the finitude of every “mode,” i.e., system. The quote speaks of the fate of man, but this is to give concrete expression to what is really an abstract proposition: every mode is finite – has an environment – and thus is not the adequate cause of its own fate. Spinoza’s philosophy – except for his determinism – is a systems metaphysics, as Jonas (1965) has noted (Jonas characterized it as a “philosophy of organism”). Incompleteness, the necessary affliction of wholeness, which manifests in both internal constraint and external limitation, is the most general explanation for evil.

A systems ontology is Leibnizian in its exposition of metaphysical evil, but anti-Leibnizian in its implications. Leibniz held this to be “the best of all possible worlds” –

with emphasis on “possible” – for which he was deservedly mocked by Voltaire. The systems view is the opposite of this: perfection is not of this world, but perfecting is. The world is perfectible, probably indefinitely so. This means that it is *never* the best that is possible – in game-theoretic language, games are very rarely zero-sum and conditions are hardly ever Pareto-optimal. But perfecting is not guaranteed by history, as Hegel and Marx thought, since contingency is real. The task of perfecting (in Kabbalah, *tikkun*) is in the hands of life, and more specifically, human life. Imperfection in the human sphere is partially and provisionally remediable; we can affect and are thus accountable for the quality of our own domain of existence. Many aspects of the natural order that cause suffering are also corrigible. Though we are not to blame (but merely partake in it), we are still responsible. By accepting this responsibility, we become the mediating factor through which polarities may be integrated and transformed. We are charged with the rectification of creation and our actions have metaphysical significance.

Tikkun begins at home, with the religious traditions themselves, which are systems of thought and practice in the real world and thus necessarily imperfect. This does not mean that just the followers of the traditions are imperfect; the traditions themselves are flawed. This is plain from any historical or scientific perspective. A systems theodicy implies the need of each tradition to face its errors and distortions. No religion is truly universal: each is a mixture of the universal and the unique, and suffers the contradictions that this entails; and each is incomplete. Every uniqueness needs other types of uniqueness – the realm of the sacred is an ecosystem, not a single species – and so “religious pluralism is the will of God” (Heschel 1996). All religions navigate clumsily the conflicting demands of variety and constraint, openness and closedness, rigidity and flexibility, centralization and decentralization. All encompass more than what can be consistently organized, and so all are afflicted by contradiction. All were fixed in some deep way, for good and bad, by their origins. All, in some places at some times, turned into their opposites. The acceptance of the fact of imperfection and the value of pluralism are bitter pills for any tradition to swallow, but this acceptance is crucial to rectify tradition and ease relations between religious civilizations. The contrary belief – in the perfection of tradition or of the central figures of tradition – is a form of idolatry. That imperfection and fallibility must be accepted is a central spiritual lesson of modernity and science.

2.2 Sacred isomorphisms

“As his books show, Davies's claim [that ‘science offers a surer path to God than religion’] depends on treating virtually all religious questions as depending on cosmological propositions centering on the Big Bang. But actually, not many questions of general importance do depend on views about that bang, however big... Most religious questions arise within human life and begin by asking about its immediate meaning...Our metaphysical ideas are rooted in the life that we know.” - Midgley (1992)

Systems metaphysics has relevance to religion beyond the secular theodicy it offers. It is instructive to think about this in the context of the many connections to religion that have been claimed for modern science and especially for physics. Religious significance has been seen, for example, in speculations about the origin of the universe and in the exquisite match between the values of the fundamental physical constants and the values necessary for a cosmos to support life (the anthropic principle). Similarities have been

noted between quantum theory and the reports of mystics. Human consciousness has been asserted to be implicated in quantum measurement, and there is much talk about classical and quantum ‘levels of reality.’

While such claims are intriguing, their scientific merit is uncertain; more critically, their spiritual significance is not substantial. These ideas appeal because they make us comfortable. They tell us that we live in a universe that is not alien but precisely tailored to our existence. They reassure us, despite our experience to the contrary, that reality at its deepest level is a seamless and harmonious web. Or, they feed fantasies of self-importance: we ourselves reduce the cosmic wave function and our very own glorious ‘consciousness’ creates the universe. They declare the limitlessness of our power by telling us that we tap into a primal subatomic energy. They flatter us by suggesting that we are the equals of the mystics because our quantum theory also speaks about the unity of existence. It is interesting to note that the extreme inflation of our importance implicit in these ideas is the mirror image of the extreme deflation of our importance that is the message of fundamentalist secularism.

These are ideas that are conducive to reverie, solipsism, and self-satisfaction, not to objectivity, presence, and effort. At best, they undermine narrow models of the world, nourish our sense of wonder, and provide a scientific hint, however metaphorical and remote, of important truths not encompassed by the dominant scientific world view. At worst, however, they are moral distractions, spiritual soporifics, and breeding grounds of intellectual dishonesty. They allow us to repress the humiliations of the Copernican, Darwinian, and Freudian discoveries. While they foster hope of regaining the coherence of the medieval world view that was undermined by science, this hope is misplaced. Attempts to find religious implications in physics are a sign more of the wish for reconciliation between science and religion, than of any progress already made towards such reconciliation. Little progress has actually been made, and the reason for this is plain: the ideas of modern physics are weakly connected to human experience.

Another reason that little progress has been made is that attempts to reconcile science and religion have often tried to establish a link between science and belief in God. This line of inquiry is virtually certain to have limited productivity. The history of attempted proofs of the existence of God lacks convincing success, and it is unlikely that science can assist in such efforts. Admittedly, the anthropic principle *is* suggestive of the classic “argument by design” once central to natural religion, but it hardly qualifies as a proof. This exception notwithstanding, for a productive dialog to occur between science and religion, the position of methodological atheism (Habermas 2002) has to be adopted, since ‘God talk’ is inherently outside any scientific framework. To be more precise: bridges built from science towards religion must reflect this position, but this constraint doesn’t apply to bridges built in the other direction.

What is required from science is something different: a metaphysics not distorted by materialistic reductionism. In this new metaphysics, physics needs to be displaced by biology as the science most relevant to a new world view. A philosophy of biology needs to be developed that corrects the tendentious denial of progress and the exaggerated emphasis on randomness that currently characterizes our understanding of evolution. The

philosophical implications of autopoiesis, the significance of the augmentation of the categories of matter and energy with those of information and utility, the inherent link of fact and value in the domain of life, the scale of complexity and potency that qualitatively differentiates living forms, the emergent and strictly immanent ‘design’ of evolutionary processes channeled by the “adjacent possible,” the natural emergence of mind, the evolutionary ratchet of altruism – these and many other systems-oriented themes are far more important to the science-religion dialog than speculations on the origins of the universe or strained imaginings of a “God of the gaps” who silently intervenes in the interstices of natural processes. We feel the absence of a world view – “Tis all in pieces, all coherence gone” Donne (1611) wrote – and we hope that this coherence might be recovered by science itself. This hope may be justified, but quantum mechanics, particle physics, and cosmology are the wrong places to look. The right place to look is to a metaphysics linked to mathematics and science and oriented towards the general, not the fundamental, the metaphysics whose construction is underway in the systems project.

A metaphysics that accords “ontological parity” (Ross 1980) to phenomena on all scales could promote a modern equivalent of the integration of science and religion that occurred in Pythagorean thought and later also permeated the origins of science as it emerged from its Western religious matrix. The systems view reasserts the Hermetic principle, “As above, so below”: the laws governing different domains of existence are the same, not in the sense that everything is reducible to physics and is just the play of elementary particles, but in the sense that there are universal structures and processes, extensive isomorphisms, that exist between many kinds of systems. Scientific knowledge was once partially organized in this way, and by virtue of this mode of organization, it was not set apart from other forms of human knowledge. It might be so again. Perhaps the laws of the macrocosm (the universe) *are* in some ways isomorphic with the laws of the microcosm (the human being); with such isomorphisms (not yet available) a reconciliation of science and religion would become imaginable.

But the isomorphisms of contemporary science depict a cosmos that is different from the Pythagorean and Hermetic visions. Beyond the geometry of simplicity, of spheres and triangles, we now have a geometry of complexity, of mountains and trees, a fractal geometry of nature. Beyond statics, which can yield simple musical analogies about harmonious ratios, we have nonlinear dynamics, which can offer isomorphisms with the complexity of Bach. The older views were too simple; they overemphasized harmony, or they assigned harmony to the heavens and discord to earth. The world is not strictly harmonious; nor is it only a vale of tears. It is a blend of the harmonious and the disharmonious; or, in contemporary systems terms, it is at the edge between order and chaos. Where these opposites meet or are joined together, there is hazard, and it is not – as Plato asserted – that there is perfection at the higher levels and hazard only at the lower ones; there is hazard all the way up. On the opposite side of hazard is opportunity; there is no hazard if nothing important is at risk. Any reality-based theodicy must acknowledge the compelling fact of hazard in the world.

The systems theory literature often touches upon religious themes. Deutsch, in his classic *Nerves of Government* (1966) speaks eloquently of ‘faith,’ ‘love,’ and ‘spirit’ within the framework of cybernetic ideas. For Deutsch, religious commitment requires a

kind of closedness but responsiveness to the present requires openness; having a harmonious balance between the two is perhaps ‘grace.’ Beyond *metanoia*, individual spiritual work, there is also *tikkun*, redeeming social action in the world, and many systems ideas are relevant to such action. For example, Boulding’s work on conflict and cooperation (1962) and Axelrod’s *The Evolution of Cooperation* (1984) show how game-theoretic ideas bear significantly on moral issues and bridge the divide between fact and value.

The systems view privileges form and process over substance, wholes over parts, and emergence over reduction. It accords ontological status to systems at all scales, to function as well as structure, and to the possible as well as the actual. There are also other compatibilities and links between systems ideas and the religious traditions. Systems theory models gradations of purposefulness. It sees planetary life as a self-regulating whole that arises from and has significance in a cosmological context. The “edge of chaos” idea allows one to model the union of order and creativity in nature. Boulding’s hierarchy of systems types (1956) is in effect a scientific reformulation of the “great chain of being” (Lovejoy 1936). The triad of matter, energy, and information echoes the three gunas of the Samkhya tradition of India. The noosphere of Teilhard (1959) exists in rudimentary form in the Internet, and the distance between certain conceptualizations of ‘angel’ and the idea of ‘meme’ is not so great. Numerous other religious ideas have systems-theoretic cognates. Systems metaphysics could be central to a new world view that has extensive and subtle religious implications.

2.3 Inner science

There is an intimate connection between systems theory and religion that is more than purely philosophical or theological: systems ideas resemble conceptions that have guided religious practice. In the Pythagorean and Hermetic traditions, theory expressed in analogies and open to experiential verification gave spiritual practice a partially scientific character. For example, alchemy as a psychological-spiritual pursuit was inner inquiry guided by an elaborate and emotionally rich system of chemical metaphor (Jung 1983). For those alchemists who were seeking something other than wealth, processes such as fixation, volatilization, and sublimation had symbolic and not literal meanings; they were not about ordinary materiality. Consider for comparison Langton’s (1992) analogy between the phases of matter and different attractor types in dynamic systems: systems with fixed point or limit cycle attractors and thus short transients are ‘solids’; systems with chaotic attractors and long transients (but short ones viewed statistically) are ‘gasses.’ The similarity between this analogy and alchemical analogies may be distant, since psyches are much more complex than simple dynamic systems (as is represented in Boulding’s hierarchy of system types), but the point is this: symbols, analogies, and isomorphisms all reflect the same systems-theoretic mode of thought. Symbols have the greatest subtlety and range, isomorphisms are the most exact, and analogies are somewhere in-between.

Burkhardt (1960) in his description of alchemy writes, “In this way too the alchemist works. Following the adage *solve et coagula*, he dissolves the imperfect coagulations of the soul, reduces the latter to its materia, and crystallizes it anew in a nobler form.” To express this in systems language, the alchemists were engaged in a psychic process of

simulated annealing, which is a method of global optimization formalized by statistical mechanics. In simulated annealing, dissolution and coagulation are done to get beyond local optima. More generally, the separation of an informational domain from a matter-energy base is central to life and exemplifies alchemical distillation and etherialization; in spiritual work these processes describe the separation of consciousness and attention from thought and sensitivity.

Certain aspects of religious traditions and spiritual disciplines resemble scientific investigation. They involve “inner sciences,” centered in the empirical experimentation of individuals, undertaken in a community of like-minded investigators, and supported by relevant theory (Zwick 1985). The experimental subject in these sciences is oneself, as is the experimenter; methods of research and knowledge gained from research can hardly be more personal than this. While theory provided by religious texts is primarily concerned with the psychological and spiritual, it often has a wider scope. Insofar as spiritual practice is guided by principles that apply to phenomena both internal and external and at different scales, and insofar as this theory could be or already is systems-theoretic, there is a link between modern science and those aspects of spiritual traditions that are partially scientific in character. In these inner sciences, theory *must* be personally appropriated if it is to have any value; for this reason it is sometimes veiled, so discovery is not short-circuited, investigation is not biased by expectation, and knowledge is not mistaken for understanding. This mode of acquiring self-knowledge differs from introspection, which does not have an experimental component. It differs also from therapy in the greater role of the subject/object of research and the lesser role of its guide (teacher, therapist), but all self-knowledge requires the active efforts of those who wish to acquire it. To some extent, this kind of self-study also resembles phenomenological investigation (Husserl 1965), but it exceeds the latter in its ethical dimension, interpersonal collaboration, tradition of theory, participation of the body, and generally in its greater scope.

Theories in the inner sciences often employ the symbolism of number to structure analogy. Chinese philosophy emphasized “correlative tabulations,” i.e., analogies across different domains of the natural and social order (Needham 1956); Chinese medicine, Taoist meditation, and *t'ai chi* share with this philosophy some common theoretical ideas. A systems-theoretic version of such number symbolism is Bennett's “systematics” (1966), which can be considered an application of graph theory to the composition and decomposition of ideas. For example, the ‘tetrad’ is a four term system describing ‘activity,’ especially purposeful activity. Its terms are ground, goal, direction, and instrument; or alternatively: actual, ideal, theoretical, and practical. The cyclic structure actual→ideal→theoretical→practical(→actual) captures the flow of many problem-solving activities: one compares the actual to the ideal, theory suggests how one can reduce the discrepancy by using some practical instrument which changes the actual conditions, and the process repeats. This particular structure is a cyclic directed graph having only dyadic links, but many other structures can be constructed with these four terms; structures where three or more terms are linked are called hypergraphs. Bennett's systematics does not explore all the graph and hypergraph structures or develop the connections between these structures and specific theories in the sciences, but it is an ‘exact metaphysics’ that is very suitable for personal use. More recently, the Arica school which advertised itself as offering a “technology of consciousness” also taught a

theory (“trialectics”) organized around non-classical logic and isomorphisms (Horn 1983) that is related to systematics.

Theories in the inner sciences also often include models of the human being that cover a wide range – from the physiological to the sensory-motor, to the emotional, to the rational, and beyond these to the spiritual. The hierarchical scheme of energies given by Bennett (1961), referred to earlier, is an example of such a model. While a holistic view of human function is inconceivable for mainstream science, which cannot integrate multiple qualitatively distinct levels of biology and psychology, systems theory has always emphasized the importance of “a coarse-grained look at the whole” (Gell-Mann 1994). Here one sees the price of scientific specialization: there is not today – and most scientists would say there can never be – any scientific grasp of the human whole that spans the above range. But systems-theoretically, this is not an unreasonable aspiration. If models offered by the inner sciences could be given mathematical formulations and be linked to rich bodies of empirical fact, i.e., if they were part of an ‘exact and scientific metaphysics,’ much coherence would be added to our sense of what it is to be human.

There are many issues involved in spiritual practice that could be described in systems language. There is the need for openness and closedness, interdependence and autonomy, commitment and flexibility. External constraint is inescapable, but there can be a choice of ‘relevant environment’; internal mechanization is lawful, but higher levels are less subject to it. There is the possibility of becoming familiar with those external and internal forces that govern our states, and the beginnings of freedom are in such awareness. There is the search for essence, for uniqueness and universality in oneself and others. Unity can be furthered by seeing multiplicity; consistency can emerge by seeing contradiction. There is promise and danger in ‘higher levels of being,’ and opportunity and difficulty in relating the highest to the whole. Though the virtual mimics the real, objectivity is not completely unattainable. There is the challenge of taking responsibility for – even perceiving – the externalities of our actions, and the potential of transforming self-interest into altruism by expanding ‘self’ and by recognizing both the similarity and difference of ‘other.’ There is the possibility of acceptance of – even gratitude for – our wholeness and partness, our incompleteness, our finitude.

One might thus conceive of spiritual practice supported by theory expressed in the language of systems laws. Something like this was imagined by Hesse in his *Magister Ludi* (*The Glass Bead Game*) published in 1943, when the systems movement was just beginning to crystallize. Hesse was prescient both in portraying the emergence of a systems-oriented (though he did not use this word) world view and the religious potential inherent in it. A quote from the book’s Foreword makes this explicit:

“Members of the [Castalian] order must seek to coordinate all the arts and sciences into a whole which transcends the sum of the constituent parts; something akin to what Robert Bridges, I presume, had in mind, when in ‘The Testament of Beauty’ he wrote of the ‘accord of Sense, Instinct, Reason, and Spirit.’ For those who attain a proficiency in it, [the Glass Bead Game] is raised to the level of a mystic rite, in which the acutest mental awareness is coupled with a Yoga-like discipline of

meditation. Music – in particular the ‘pure’ music of Bach – and mathematics are the foundation stones upon which the whole complicated structure is erected.”

In his novel, Hesse also expresses the insularity – and thus the limitations and dangers – of an overdevelopment of the abstract that is insufficiently balanced by the concrete, an essence-flaw that too often afflicts both the discourse of spiritual tradition and that of systems theory. Imperfection reigns in these domains as well.

2.4 Summary

Religion speaks to our emotional nature by employing myth, but insofar as it addresses our intellect, it must speak in the language of reason. In the modern era, the dominant mode of reason is science. Sacred truths need *also* to be cast in scientific form. The idea of “two magisteriums” (Gould 1999), that is, two kinds of understanding – religion and science – completely separate from one another, is the counsel of despair. More than this is both possible and necessary. Through systems ideas a link between science and religion could be made that is substantive and not superficial. It would offer more than the mere intellectual fascination that modern physics provides to those who browse in its theories. It would provide a meaningful world view, and also connect science to the core of religious truth that can be discovered only in practice.

A productive encounter between modern science and religious tradition would begin the recovery of cultural coherence. It would also open up possibilities of communication between the different religious traditions by providing a neutral scientific background, as it were, for such dialog. Religion will never be reconciled with science if it reflects the perspective only of one tradition. No aspect of science offers greater support for the science-religion dialog and the unity of religion than the systems world view that seeks to embrace the whole but does not flinch from the impossibility of doing so. In the recovery of old forms of knowledge eclipsed by science, in the establishment of a new connection between religious and scientific understanding, in the ingathering of traditions and the correction, refinement, and augmentation of the great sacred approximations, systems theory and systems metaphysics have important contributions to make.

References

- Arnheim, Rudolph (1971). *Entropy and Art: An Essay on Disorder and Order*. Berkeley: University of California Press.
- Ashby, W. Ross (1976). *An Introduction to Cybernetics*. London: Methuen.
- Axelrod, Robert (1984). *The Evolution of Cooperation*. New York: Basic Books.
- Bennett, John G. (1956). *The Dramatic Universe, Volume One: The Foundations of Natural Philosophy*. London: Hodder & Stoughton.
- Bennett, John G. (1961). *The Dramatic Universe, Volume Two: The Foundations of Moral Philosophy*. London: Hodder & Stoughton.
- Bennett, John G. (1966). *The Dramatic Universe, Volume Three: Man and His Nature*. London: Hodder & Stoughton.

Blair, D. H. and Pollak, R. A. (1983). "Rational Collective Choice." *Scientific American*, Aug., pp. 88-95.

Blake, William (1802). "Letter on Sight and Vision," to Thomas Butts.

Boulding, Kenneth (1956). "General Systems Theory – the Skeleton of Science." *Management Science* 2, pp. 197-208. Reprinted in Buckley, ed. (1968), *Modern Systems Research for the Behavioral Scientist*. Chicago: Aldine, pp. 3-10.

Boulding, Kenneth (1962). *Conflict and Defense*. New York: Harper and Row.

Bronowski, Jacob (1970). "Stratified Stability and Unbounded Plans." *Synthese* 21, 228-246.

Bunge, Mario (1973). *Method, Model, and Matter*. Boston: D. Reidel.

Burkhardt, Titus (1960). *Alchemy*. London: Penguin.

Caws, Peter (1988). *Structuralism: The Art of the Intelligible*. New Jersey: Humanities Press.

Calhoun, Craig (1995). *Critical Social Theory: Culture, History, and the Challenge of Difference*. Oxford: Blackwell.

Culler, Jonathan (2000). *Literary Theory: A Very Short Introduction*. Oxford: Oxford University Press.

Deutsch, Karl (1966). *The Nerves of Government*. New York: Free Press.

Donne, John (1611). "The Anatomy of the World."

Gell-Mann, Murray (1994). *The Quark and the Jaguar: Adventures in the Simple and the Complex*. W. H. Freeman & Co., New York.

Gerard, Ralph W., ed. (1958). *Concepts of Biology*. Publication 560. Washington, DC: National Academy of Sciences – National Research Council.

Gould, Stephen Jay (1995). "The Pattern of Life's History." Chapter 2 in John Brockman, *The Third Culture*. New York: Simon & Schuster.

Gould, Stephen Jay (1999). *Rocks of Ages: Science and Religion in the Fullness of Life*. New York: Random House.

Gregersen, Niels Henrik (2003). *From Complexity to Life: On the Emergence of Life and Meaning*. Oxford: Oxford University Press.

Habermas, Jurgen (2002). *Religion and Rationality: Essays on Reason, God, and Modernity*. Cambridge: MIT Press.

Hayles, N. Katherine (1990). *Chaos Unbound*. Ithaca: Cornell University Press.

Hervey, S. (1982). *Semiotic Perspectives*. London: Allen & Unwin.

Heschel, Abraham Joshua (1996). *Moral Grandeur and Spiritual Audacity*, Susannah Heschel, ed., New York: Farrar, Straus & Ciroux.

Hesse, Herman (1943). *Magister Ludi (The Glass Bead Game)*. Holt, Reinhart & Winston.

- Husserl, Edmund (1965). "Philosophy as rigorous science." In *Phenomenology and the Crisis of Philosophy*. Quentin Lauer, transl. New York: Harper & Row.
- Jonas, Hans (1965). "Spinoza and the Theory of the Organism." *Journal of the History of Philosophy*, 3, pp. 43-58. Reprinted in Grene, Marjorie, ed. (1979). *Spinoza. A Collection of Critical Essays*. Notre Dame: University of Notre Dame Press, pp. 259-278.
- Jonas, Hans (1966). *The Phenomenon of Life: Towards a Philosophical Biology*. Evanston: Northwestern University Press.
- Jung, Carl (1983). *Collective Works of C.G. Jung, Vol. 13: Alchemical Studies*. Princeton: Princeton University Press.
- Kauffman, Stuart (1993). *The Origins of Order: Self-Organization and Selection in Evolution*. Oxford: Oxford University Press.
- Kauffman, Stuart (2000). *Investigations*. Oxford: Oxford University Press.
- Kauffman, Stuart (2003). "The Emergence of Autonomous Agents." In Gregersen (2003).
- Koestler, Arthur (1959). *The Sleepwalkers: A History of Man's Changing Vision of the Universe*. London: Penguin.
- Langton, Christopher (1992). "Life at the Edge of Chaos." In *Artificial Life II. SFI Studies in the Sciences of Complexity, vol. X*, ed. by C.G. Langton, C. Taylor, J.D. Farmer, & S. Rassmussen, Redwood City: Addison-Wesley.
- Lévi-Strauss, Claude (1966). *The Raw and the Cooked: Introduction to a Science of Mythology*. London: Penguin.
- Lovejoy, Arthur O. (1936). *The Great Chain of Being: A Study of the History of an Idea*. Cambridge: Harvard University Press.
- Margulis, Lynn (1998). *Symbiotic Planet: A New Look at Evolution*. New York: Basic Books.
- Midgley, Mary (1992). *Science as Salvation: A Modern Myth and Its Meaning*. New York: Routledge.
- Miller, James G. (1978). *Living Systems*. New York: McGraw-Hill.
- Moles, Abraham (1966). *Information Theory and Esthetic Perception*. Urbana: University of Illinois Press.
- Monod Jacques (1972). *Chance and Necessity*. New York: Random House.
- Needham, Joseph (1956). *Science and Civilization in China, Vol. II. History of Scientific Thought*. Cambridge: Cambridge University Press.
- Neiman, Susan (2002). *Evil in Modern Thought: An Alternative History of Philosophy*. Princeton: Princeton University Press.
- Nicolis, G. and Prigogine, Ilya (1977). *Self-Organization in Nonequilibrium Systems: From Dissipative Structures to Order through Fluctuations*. New York: John Wiley.
- Piaget, Jean (1970). *Structuralism*. New York: Basic Books.

- Polanyi, Michael (1958). *Personal Knowledge: Towards a Post-Critical Philosophy*. New York: Harper & Row.
- Rosenblueth, Arturo; Wiener, Norbert; and Bigelow, Julian. (1943). "Behavior, Purpose, and Teleology." *Philosophy of Science*, 10, pp. 18-24.
- Ross, Stephen David (1980). *Transition to an Ordinal Metaphysics*. Albany: State University of New York Press.
- Scholem, Gershom (1991). *On the Mystical Shape of the Godhead*. New York: Schocken.
- Spencer-Brown, George (1969). *The Laws of Form*. London: George Allen & Unwin Ltd.
- Teilhard De Chardin, Pierre (1959). *The Phenomenon of Man*. New York: Harper & Row.
- Whitehead, Alfred North and Russell, Bertrand (1910-1913). *Principia Mathematica*. Cambridge: Cambridge University Press.
- Whyte, Lancelot Law (1965). *Internal Factors in Evolution*. New York: George Braziller.
- Wilson, Edward O. (1998). *Consilience: The Unity of Knowledge*. London: Little Brown.
- Wright, Robert (2000). *Non-Zero: The Logic of Human Destiny*. New York: Pantheon.
- Zwick, Martin (1984). "Incompleteness, Negation, Hazard: On the Precariousness of Systems." *Nature and System*, 6, 33-42.
<http://www.sysc.pdx.edu/download/papers/incomplete.pdf>
- Zwick, M. (1985) "Personal Knowledge and the Inner Sciences." A talk at the conference on "*Other Realities: New Religions and Revitalization Movements*," University of Nebraska, Lincoln, Nebraska, March 27-30.
<http://www.sysc.pdx.edu/download/papers/polanyi.pdf>
- Zwick, Martin (1995). "Towards an Ontology of Problems." *Advances in Systems Science and Applications*, Special Issue I, pp. 37-42.
http://www.sysc.pdx.edu/download/papers/mz_ assa_met.pdf
- Zwick, Martin (2000) "Understanding Imperfection." *World Congress of the Systems Sciences & 44th Annual Meeting of the International Society for the Systems Sciences*, Toronto, July 16-22, 2000. <http://www.sysc.pdx.edu/download/papers/iss plenary.pdf>