Many Types of Creativity are Evolutionary Processes

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Abstract

Systems chaos theory poses the circular paradox of self-organization. In resolving this paradox an abstract law of science (a cybernetic version of the second law of thermodynamics) implies that self-organization is an evolutionary process defined by three characteristics: (1) order, chaos, hierarchal new order process (2) that is achieved by trial-and-error selection of it (3) by possible, stable collaborations intrinsic to a particular environment. The many types of creativity that have these three features include: scientific constructivism – the core idea of the Enlightenment – narrative constructivism that uses subjective understanding of metaphorical concepts and is appropriate virtually to all disciplines including science, artistic creativity – such as poetry, music, painting, literature, dance – psychological transformations – such as stages of individuation from childhood to adulthood and transcending stress – and spiritual/religious conversions as exemplified by recovering addicts in alcoholic anonymous (AA) and Evangelical, born-again Christians. The anguish and suffering one may experience during the chaos phase of a human self-conscious evolutionary process may require and therefore lead to Faith in an ultimate SOURCE specified as a Higher Power by AA, Christ, God the Father of Judaism, Allah, Emptiness of Buddhism, or other. Understanding evolutionary creativity as connecting science, humanities, art, spirituality and religion could transform high school and college education.

Introduction

The body of this paper, which I wrote before reading Richard Dawkins' book, *The Selfish Gene*, describes a universal theory of creativity that includes Dawkins' view of the emergence of life on earth and its evolution to the current biosphere ecology. In the last three pages of the 30th year edition of *The Selfish Gene* Dawkins summarizes his thesis in terms of the core ideas: replicators, randomness, imperfect copying that produces variations of replications of a replicator, collaborations, and natural selection involving the efficiency of replication, collaborations, and the influence of the environment. Randomness leads to the emergence of replicators that make copies of some pattern and leads to variations of replicator copies. However one defines life, a living system certainly involves: (1) a hierarchal network of collaborations among components of the system, (2) collaborations among the system and components of its environment, (3) replication processes that directly or indirectly lead to the reemergence of "life collaborations," (4) variations of life collaborations, and finally, (5) the replication process itself involves a set of collaborations. Natural selection "chooses" those replicators that are the most efficient and that lead to life collaborations that are the most stable in a particular environment over an extended period of time that allows for thousands of generations of reemergence of life collaborations.

According to Dawkins: “As time goes by, the world becomes filled with the most powerful and ingenious replicators” (Dawkins 2006, 265). The most powerful replicators are those that are the most efficient and that produce life collaborations that are the most stable, as “judged” by natural selection, and the most ingenious replicators are the ones that produce the most cooperative, hierarchal collaborations, again as judged by natural selection. Evolution of life is the continual emergence of new sets of life collaborations. This process may be represented as old life collaborations that go into some degree of chaos from which emerges, by trial and error natural selection, a newly modified set of life collaborations that implies the old set from which it emerged. As a result, this evolution is a narrative that involves creating new patterns.

One of the major theses of the body of my paper may be summarized by three sub-themes that relate to Dawkins’ thesis. The first sub-theme is that many processes in nature may be represented by the mathematical theory of probability. The second sub-theme is that the most general version of the second law of thermodynamics not only describes the functioning of any machine, it describes all empirical processes-events in nature including creative evolutionary processes. The theory of probability postulates that any random process always produces one of two or more possible, autonomous, random outcomes, as for example, tossing a coin leads to either a heads or a tails. A random event is “described/defined” as an outcome of a random process that when repeated an indefinitely large number of times leads to a particular frequency of each of its outcomes. For example, tossing an unbiased coin a large number of times leads to a frequency of 50% heads and 50% tails. The frequency is said to be the “probability” of obtaining that outcome. Thus, any process in nature represented by the theory of probability is a replicator of frequencies; that is to say, it generates particular probabilities. According to the second law of thermodynamics, any closed system in nature tends to irreversibly go to greater

chaos, mathematically represented as an increase in entropy. Two or more systems may collaborate to produce a complex system that tends toward greater chaos. However, under some circumstances the nature of the collaboration is such that as one system goes to greater chaos, the second system (open system far from equilibrium undergoing high energy flux through it) decreases its degree of chaos. This decrease is equivalent to the emergence of new collaborations within the system and/or between the system and its environment. The emergence of new collaborations is the universal, creative process that applies to evolution of non-living systems as well as living systems described by Dawkins. A cybernetic, probabilistic representation of the second law represents this universal, evolutionary process. When one understands this mathematical theory in terms of a metaphorical, conceptual, objective, narrative knowing, then one can "see" that universal evolution involves old collaborations going to some degree of chaos that leads to natural selection of new collaborations. The idea of natural selection applies to non-living as well as living systems. Furthermore, an objective, narrative understanding of nature enables one to apply universal evolution to all the disciplines of knowledge including theologies.

This understanding of universal evolution also leads to two core ideas of the *fourth Enlightenment* that is emerging in modern societies around the world. These ideas will be summarized in the conclusion of this paper.

Evolution Of Scientific Positivism To Levels Of Constructivism

Hierarchal, Scientific Constructivism

Anyone who has a pet knows that some animals consciously recognize patterns. The pet owner establishes certain routines, sometimes associated with words, and the dog or cat recognizes certain cues and then prepares to participate in the routine. For example, when my wife or I mention getting take out for dinner, our dog, Goddy, starts preparing to get into the back seat of my car. The difference between humans and other mammals is that humans are to some degree conscious of themselves being conscious of some pattern or an event. When a human becomes civilized, which in modern societies usually occurs in the seven to eight year old child, he/she can construct a conceptual, language representation of perceived patterns. A young person who has developed logical, conceptual thinking can understand or even construct logical, conceptual models of patterns that are thought to be objective, true representations of nature. At the still higher level of individuation, which is the scientific, autonomous self, one can understand or create a theory of some pattern in nature that is neither true nor false but can be valid in a particular context. This approach is called *scientific constructivism* that may evolve to hierarchal levels of describing nature. For example, Newton's theory of motion is valid for objects moving far from the speed of light but must be replaced by Einstein's special theory of relativity for objects moving close to the speed of light. Newton's theory has aspects that not only contradict Einstein's theory but does not imply that theory; Newton's theory cannot be simplified to or reduced to Einstein's theory. Einstein's theory represents a hierarchal description of nature in that it is a complex theory that includes Newton's theory; that is, it can be reduced to Newton's much less complex description of motion. Thus, Einstein's theory implies Newton's theory, but Newton's theory does not imply Einstein's theory. This non-reciprocal relationship is why Einstein's theory, by definition, is a hierarchal description of nature. A two-level hierarchy, such

as life and non-life, means that the higher implies the lower level, but the lower does not imply the higher level.

A scientific constructivism description of the Carnot ideal heat machine provides the foundation for formulating thermodynamics that also exemplifies a hierarchal, scientific description of nature. The first law of thermodynamics expanded Newton's ideas to include the concept of energy metaphorically understood as a substance that flows from a higher to a lower level into or out of a system. There are two kinds of energy; mechanical energy that describes motion and thermal energy that describes change of temperature. A difference in level of energy was called potential energy that represents structure equal to order in nature. A loss of order in one place always shows up as an equal amount of order some place else. In the perspective of the first law, time is analogous to a dimension in space and thus is reversible. In this extended mechanistic world every event is predictable, thus implying determinism, and there is no loss of order; that is, no chaos.

The formulation of the second law of thermodynamics radically broke from a gross, mechanistic description of nature. In this new perspective energy no longer can be thought of as a substance that flows. Rather, energy is paradoxical in that it has two aspects that seem to oppose one another. On the one hand, energy is a *potential* (not the same as potential energy because kinetic energy also is a potential to do work) for two types of events to occur: (1) heat event where there is a change in temperature and (2) a work event plus a heat event where there is a change in motion and a change in temperature. *There is no potential in nature for only a work even*t. Potential represents the order aspect of nature. On the other hand energy is *flux* in which a potential transforms into a heat event or a work event plus a heat event. As a result of flux, the original potential equal to order is gone forever, and so flux is associated with the loss

of order, which is the same as chaos. Furthermore, according to the second law, this loss of order sometimes may lead to creating a new order elsewhere in nature, but the quantity of the new order, called *negative entropy*, is less than the quantity of old order; that is, the new order has greater entropy than the old order. The usual way of saying this is that in any change from old order to new order, there always is a net increase in entropy that is to say, a net decrease in order equal to a net increase in chaos, which is a net decrease in negative entropy.

The original definition of entropy is that it always is associated with flux and is a measure of the quantitative change in order of a system. That is to say, entropy of any system in flux is a measure of its chaos. As a result of any flux in nature, the net entropy always increases; that is, net chaos always increases meaning that the net order always decreases. This means that, since any event always occurs over time, any and every event is irreversible. *There is no event in nature in which there is a net increase in order corresponding to a net decrease in chaos*. This being the case humans subjectively experience time as irreversible contrary to what Einstein maintained as a result of his theories of relativity. This entropy law implies that we acknowledge subjective perceptions as well as objective representations of these perceptions. This law also implies indeterminacy and lack of knowing. During any flux, we can know the initial state before the flux and the final state of a system after the flux, but there are an indefinite number of ways for the transition to the final state to occur.

Ideal Heat Machine Implies Collaboration of Two Fundamental Drives in Nature

The description of an ideal heat machine also implies seven interrelated generalizations about the functioning of any machine (Pribor 2004, 19-27). These generalizations lead to the following description of the functioning of any machine. Every machine has one or several interconnected

energy couplers; the set of interconnected energy couplers is equivalent to a single energy coupler. A potential in nature communicates with an energy coupler. This communication may be interpreted as an energy flux involving a transfer of information to the energy coupler resulting in it having a potential to accomplish a small machine task. The energy coupler then transfers information to the environment resulting in a small machine task. Repetition of the cycle of the energy coupler leads to the sum of many small tasks equal to the large task of the machine. Any machine as an autonomous system does not accomplish a machine task. Rather, the machine accomplishes a task only as a result of it collaborating with a potential in nature. The sequence of energy events of one cycle of an energy coupler in any machine is as follows: (1) As an order in nature goes to chaos, the resulting energy flux leads to a heat event plus the energy coupler acquiring the new order (order out of chaos) of a potential to do a small task; (2) as the task potential of the energy coupler goes to chaos, the resulting flux leads to a heat event plus a work task such as a small motion of a car; (3) some of the energy flux into the machine leads to the non-machine task of bringing the energy coupler back to its initial state so that it can start a new cycle; this non-machine task is why even the ideal heat machine is not 100% efficient.

Each cycle of an energy coupler produces a hierarchal mutuality of chaos and *machine creativity*. The machine may be said to create a task order out of the chaos of the energy flux passing through it. The machine task work is a two-level hierarchy. The task work implies that there must have been a potential in nature to generate it (this is what the first law says), but this potential does not imply any particular task work. Thus, the higher level machine task order includes the lower level order that existed as a potential in nature. Scientific constructivism gives quantitative definitions of order, such as a quantitative definition of potential and chaos

defined in terms of the mathematical definition of entropy. When we realize and acknowledge that an energy coupler produces a two-level hierarchy, then the ideas of order and chaos must be understood metaphorically as qualities that have degrees of differences. Machine task is qualitatively different than an order in nature represented by a potential; that is, machine task is a higher level order than is an energy potential. The quantitative definition of machine task equal to work is not different than the quantitative definition of energy potential defined as the ability to do work, but, as described above, there is a qualitative difference. Likewise there are degrees of chaos corresponding to degrees of order. The energy flux into the energy coupler metaphorically may be understood as resulting from a kind of drive (representing one version of the second law of thermodynamics), which I call *Eros-chaos*. The creation of a new order of the energy coupler acquiring the potential to accomplish a small machine task metaphorically may be understood as resulting from a drive that converts energy flux into a new energy potential or a work event. I call this drive, *Eros-order*. The same ideas apply to energy flux out of the machine that leads to a small machine task. Machine creativity may be understood as the mutuality of Eros-chaos and Eros-order (Pribor 2004, 29-33). This mutuality is the more complex version of the second law of thermodynamics proposed by systems scientists.

Machine Collaboration with Nature Implies Narrative, Scientific Constructivism

The description of machine creativity involves a narrative interpretation of an historical process. Each cycle of an energy coupler is a concrete event that occurs in a particular context in thermodynamic time equal to one's subjective experience of time. The main structure of the plot of this narrative is the collaboration between the machine and a potential in nature. The actors in this narrative are humans who collaborate with nature by means of an energy coupler to achieve

some goal. This more complete description of a machine is *narrative, scientific constructivism* that points to a new, higher, more comprehensive way of understanding science. It is higher because narrative, scientific constructivism includes scientific constructivism, but for practical reasons, one can reduce the narrative involving subjective understanding of metaphorical concepts to the objective model for accomplishing a goal. It also is higher because it enables one to be open to see possible connections with other areas of science and with non-science areas of knowledge. This more comprehensive way of understanding nature overcomes fragmentation of knowledge and disposes one to participate in nature, rather than just control her; this can actuate a kind of love of nature.

Dynamic Systems Perspective Of Creating Order

A machine is a dynamic, open system in the chaos of energy flow, that is, flux, through the system. Another way of saying this is that the system is open to and to some extent not in equilibrium with the environment. A *phase space* is a system confining an entity and its relationships. Attractors are the principles or controlling factors that put order into the functioning of a phase space. That is, attractors organize the processes that occur in the phase space into specific patterns. The machine is a phase space and its energy coupler is an attractor. Because the energy coupler goes through cycles, it is a *periodic attractor*. This periodic attractor organizes energy flux as it passes through the machine – the phase space – into cycles that accomplish small work tasks. As a phase space degenerates into chaos, its attractor becomes less able to organize the energy that is passing through it. Eventually the attractor becomes unable to organize energy flux into any semblance of the pattern that it once produced. In

applying these ideas to a machine one can say that a degenerating machine will become less efficient and eventually will stop functioning – "machine death."

Modern theories of chaos have shown that some phase spaces *that are not machines* may degenerate to what is called a *bifurcation* rather than phase space death. A bifurcation is the process of a complex dynamic system degenerating into chaos, which begins to generate new possible patterns; that is, there is the possible emergence of new orders from the degenerative chaos. The continued energy flux that produced the degenerative chaos begins to become organized by what are called *strange attractors* into the emerging new patterns. As a result of strange attractors, the phase space undergoes a *transformation* to new patterns. The emergence of these new patterns are said to *transcend* the degenerating pattern. That is, instead of some internal or external control bringing the degenerating phase space back to the old pattern, strange attractors become released by the chaos to generate new patterns. A phase transition of a phase space is a degeneration to chaos that either ends in phase space dissolution or to phase space death that is followed by a transformation "rebirth" to new patterns. Thus, a dynamic systems perspective of a machine provides another defining characteristic of it. A machine eventually will degenerate to dissolution; it never undergoes phase space transformation.

Two Types Of Narrative, Scientific Constructivism

External, Narrative, Scientific Constructivism

The theory of machines leads to narrative, scientific constructivism that is a type of knowing that transcends the totally objective, mechanistic, scientific, constructivism knowing. The word "transcends" refers to the hierarchy in which narrative, scientific constructivism includes scientific constructivism but not the other way around. A systems perspective of a machine

points to a fundamental inadequacy of narrative, machine, scientific constructivism. Machine constructivism leads to a hierarchy of environment information transformed into machine work organization, but this perspective does not allow for the idea of any systems transformation. Machines have an intrinsic unity that may be called a *machine self*. A machine self can transform incoming information but it cannot transform itself. Rather the machine functions over time, but eventually it "self-destructs." In radical contrast some systems in the universe become configured into a unitary pattern that designates each of them as a system's self. Under some conditions a system's self can transform to one or more transcendental system's selfs. The word "transcendental" again refers to a hierarchy in which a newly emerged system's self includes aspects of an old system's self. Everywhere one looks at the biosphere there are instances of these system's self transformations, for example, subatomic particles become atoms, simple atoms become complex atoms, atoms become molecules, and so on. This points to a fundamental distinction between machine transformation leading to machine work hierarchies and systems transformations leading to system's self hierarchies. With this distinction in mind one may specify that machine transformations only produce information transformations in reference to an unchanging machine self. As the machine self degenerates, so also the quality of the information that it produces. The machine information transformation always is external to the machine self; it never can flow inward to become incorporated into the machine self thereby transforming it into a new machine self. Thus, any mechanistic or machine understanding of Nature is at best an *external, narrative, scientific constructivism* that never can describe a systems transformation.

Internal, Narrative, Scientific Constructivism

A complex system's self remains stable as a result of one or a set of attractors that maintain it. When one attractor or the collaboration of attractors begins to breakdown, the system's self begins to degenerate. The resulting chaos opens up hidden potentials within the system that enables intra-communications (within system communications) or communications with potentials in its environment. Collaboration among some of these communications produces information transformations that are incorporated into a degenerating old self. This internalization of information leads to the transformation of the old self into a new self. For example, degeneration of a system of hydrogen and oxygen gases leads to the chaotic systems state of some hydrogen positive atoms and some negative oxygen atoms. If this system is near the attractor called equilibrium, then intra-system communications will regenerate the equilibrium state of hydrogen and oxygen molecules. However, if the gas system is far from equilibrium, then regeneration is not possible. This facilitates intra-molecular communications that collaborate to internalize information in water molecules making up the new system's self. That is, the positive hydrogen atoms and negative oxygen atoms do not recombine to form hydrogen and oxygen gas molecules. Rather, they collaborate to form water molecules. This understanding of systems transformation results from *internal, narrative, scientific constructivism*.

Circular Paradox of System's Self-Organization

When a system's self degenerates to death and then rebirths to a new system's self, scientists say that the system has "self-organized." This leads to a more fundamental circular, paradox: How can a self transform itself? When a system's self degenerates, the system loses its ability to

maintain or re-establish a stable self, and that is all the system's self has, namely an attractor that maintains a particular pattern. System scientists say that the degenerating self dies and is reborn via a strange attractor that is a new intrinsic unity and cohesiveness toward which the system is evolving. Where does this strange attractor come from? According to the Western mentality, "Something cannot come from nothing."

Another way of making this circular paradox more evident is to ask the question: "Which is more primary, the strange attractor or the new self?" This is analogous to the question: What is more primary the chicken or the chicken egg. We know of the existence and the pattern of a strange attractor after the emergence of a new self. In other words, scientists construct the narrative of the emergence of a new system's self and then construct the idea that a particular strange attractor generated the new self. Some systems scientists' position on this is analogous to Bohm's idea of implicate Order in matter-energy that progressively becomes explicate Order over time (Bohm 1980), (Weber 1982, 191-192), (Pribor 2004, 76-78). The position is that there are infinite, non-denumerable strange attractors embedded in the implicate Order of mass-energy. Random fluxes of the universe determine where and when a particular strange attractor will be "uncovered" as a result of the degeneration of a particular system's self. In other words, transformation does not produce a new self or creativity in general is not new Order emerging from chaos but rather is explicate Order emerging from implicate Order. But then a particular set of random fluxes becomes the partial cause of the emergence of an explicate Order form the implicate Order of a strange attractor. As Bohm would argue, this set of fluxes is random at one level of analysis in which it is merely one possibility among an infinitely non-denumerable "number" of possibilities. But at a "higher" or "deeper" level of analysis, this particular set of circumstances is itself the Order of a higher level strange attractor that determines when and

where a lower-level strange attractor will be "released" to generate a new system's self. But then, what "causes" this higher level strange attractor order to come into play? The answer, of course, is a still higher level strange attractor order thus indicating the classical Aristotelian infinite regression. Aristotle's answer would be that there must be a really unique strange attractor order that is itself "uncaused." The uncaused strange attractor is Aristotle's idea of God.

Resolution Of The Paradox Of Self-Organization

Chemical Transformations Are Instances of Evolutionary Self-Organization

Sometime during a year after birth the child tacitly recognizes the pattern, things fall down and if while standing the child leans too far backward, he/she will fall down. If one adopts the scientific constructivism perspective of abandoning the preconceived ideas of substances that have eternal natures or forms and are involved in cause-effect interactions, then this pattern of "things falling" has no cause or purpose or meaning. Each instance of falling simply is *such that it is*. Newton's law of gravity does not explain why things fall. Rather, the law quantitatively describes this pattern in such a way as to enable humans to predict how much falling there is in any instance of it and to see that other events that do not appear to be a kind of falling are in fact instances of falling. For example, Galileo's insight of the pattern of planets circulating around the sun that later was mathematically described by Kepler's three laws was, after Newton, seen to be planets continuously falling toward the sun. This falling motion combined with the planet's linear motion is now seen to be its circulation around the sun. Furthermore, Newton's ideas including his three laws of motion and the law of the conservation of momentum provided later scientists to create the idea of energy and related ideas that became the foundation for

formulating the theory of machines and the most general, now universally accepted scientific-philosophical perspective of thermodynamics.

As this unfolding of new ideas was occurring, the scientists, such as Lavoiser (1743 – 1794), formulated the foundation for what we now call chemistry. Chemistry embodies a new pattern, called a *chemical reaction*, which seems to oppose the determinism of mechanistic science. For example, under conditions of high temperature and pressure a mixture of oxygen and hydrogen gases interact – we now say chemically react – to produce water that totally unlike hydrogen or oxygen is a liquid at room temperatures. Moreover, water has a host of properties that distinguish it as radically different from hydrogen and oxygen gases. Systems scientists would say that nature has manifested something new with *emergent properties* that were not at all anticipated. Another way of talking about this phenomenon is that evolution has produced a new system with emergent properties. This emergence of water from a chemical reaction is analogous to what a machine does; that is, a chemical reaction produces a new hierarchy. Water implies that there must have been a chemical reaction between oxygen and hydrogen. But before observing this emergence of water, knowing about oxygen and hydrogen did not imply the emergence of water. The emergence of new things such as water is a surprise that some thinkers interpreted as magical, that is, rationally incomprehensible. However, in the nineteenth and twentieth centuries scientific constructivists created ideas that provided a mathematical description of evolutionary surprises just as mathematical engineers gave a mathematical description of the operation of any machine and Newton gave a mathematical description of the pattern of falling down.

Mathematical Description of Evolutionary Self-Organization

Overview of the theory of probability. The first major idea to emerge that later could be used to describe evolutionary processes is the mathematical theory of probability for describing processes that have an infinite, non-denumerable "number" of possible outcomes. For example, suppose one repeats a measuring process to determine the length of a table. It is reasonable to assume that there is a unique number of linear units that represents the length of the table. A particular measuring process may produce results that range from 7.8 to 8.2 units. Modern number theory (theory of real numbers) implies that between and including 7.8 and 8.2 there are an infinite, non-denumerable "number" of numbers (real numbers). Probability theory provides guidelines for constructing one of an infinite number of probability distribution functions where probability is like a mass of paint unevenly distributed in the interval bounded by 7.8 and 8.2. The way this probability mass of paint is distributed allows infinite variation, but the total mass of this paint is 0 at the point just before 7.8 and progressively increases as one moves toward 8.2. The total probability mass in the interval bounded by 7.8 and 8.2 is 1. Some of the possible distribution functions are what mathematicians call "well-behaved," and one of the most useful of these distributions is the Gausian distribution. This distribution can be converted into a frequency function that associates a predicted frequency of occurrence of measurement results to every point in the interval bounded by 7.8 and 8.2. The frequency associated with each point in this interval is interpreted as a probability of the point representing one of the possible results of the measurement process. This Gausian frequency function looks like a bell-shaped curve where the top point of the bell is a unique characteristic of this function called the *mean value*. The mean value is assumed to be the best estimate of the actual length of the table.

Probability interpretation of thermodynamics. The next major idea that contributed to mathematically describing an evolutionary process is representing the laws of thermodynamics by probability functions. Any system is viewed as consisting of many particles where each particle has internal energy called *electro-chemical potential* that does not contribute either to heat or to work events when the system's total internal energy changes. Thus, the first law states that any change of internal energy of a system will equal to the energy that produces a work event plus the energy that produces a heat event plus the sum of changes of electro-chemical potential energy of each particle making up the system. The second law represents the entropy change of a system resulting from the system changing infinitely slow so that the system is very near to equilibrium throughout the change. It further is assumed that (1) each particle can exist in many different energy configurations, such as described by quantum mechanics, and (2) all the possible configurations of a given system are equally likely to occur. This means that the system will be in the statistically most probable configuration. Then the classical definition of entropy is equivalent to a probability distribution function representing the entropy of the system. This *statistical entropy* represents uncertainty or ignorance about the exact state of the system. Certainty would imply that one knows the energy state of each particle and the one set of relationships among all the particles of the system. In both the classical and the statistical mechanics version of the second law, when a system changes, it produces an irreversible hierarchy of two types of energy: there is *organized energy* producing a work event, which always is accompanied by *disorganized energy* producing a heat event. According to the second law, after the change of a system, its entropy has increased. This implies any one of the following three statements: (1) the system has less energy available to do work (some of the energy it had before the change was converted into disorganized energy of a heat event), (2) the

order of the system has decreased corresponding to an increase of its chaos, (3) the uncertainty of the structural state of the system has increased.

In the MaxEnt interpretation of thermodynamics (http://en.wilipedia.org/wiki/MaxEnt_thermodynamics) the statistical entropy only has predictive value that is tied to the subjective assumptions one makes about a system. (In fact, this always applies to using probability theory to predict outcomes of any concrete situation.). Statistical mechanics assumes determinism so that there is only one possible outcome of any change to a system. Statistical entropy merely represents the quantity of uncertainty about the state of any system after a change of its internal energy. While there is a net increase of entropy of the environment plus the system that changed, the statistical entropy of a system far from equilibrium may actually decrease, which seems to contradict the second law. However, from the MaxEnt perspective, this discrepancy only means that there was information about the system before the change that only became evident after the change; it really was there all the time. Such a view may be applied to understanding how oxygen and hydrogen gases react to produce water with emergent properties. The MaxEnt perspective would claim that the information necessary for predicting water with emergent properties always was there but only came to light after observing this "evolutionary" event. In any case, the classical and the statistical mechanics interpretations of thermodynamics precludes the possibility of evolution. Any system in nature cannot spontaneously decrease its entropy; that is, it cannot increase its information, which is to say it cannot accumulate information. In his article, "Thermodynamics vs. Evolutionism (Exposing the Myth of Evolution)" Timothy Wallace makes the strong argument that thermodynamics is the most fundamental and universally accepted perspective in modern science, and it refutes the possibility of evolution (http://www.trueorigin.org/steiger.asp).

However, Wallace is unaware of the formulation of the second law in terms of open systems far from equilibrium, such as described by the Principia Cybernetica Project.

Principia Cybernetica Project: Objective, Narrative, Scientific Constructivism.

The people in the Principia Cybernetica Project proclaim that while there is no absolutely true model of reality, they have constructed a universal model in which a system far from equilibrium may spontaneously internalize information. This model incorporates the idea, developed by Szilard, Gabor, Rothstein, and Brilloun (1940 – 1950), that a decrease in statistical entropy, called *neguentropy* (negative entropy) is equivalent to information. Even Wikipedia's description of MaxEnt thermodynamics states that "Quite possibly it [the decrease of statistical entropy] arises as a reflection of the evident time-asymmetric evolution of the universe on a cosmological scale" (http://wikipedia.org/wiki/MaxEnt_thermodynamics). The cybernetic model, called *Metasystem Transition Theory (MSTT),*

> is constructed by the subject or group [and uses] methodology to build…[a] complete philosophical system…[that] is based on a 'bootstrapping' principle: the expression of the theory affects its content and meaning, and vice versa…. Our goal is to create, on the basis of cybernetic concepts, an integrated philosophical system, or "world view", proposing answers to the most fundamental questions about the world, ourselves, and our ultimate values (http://pespmc1.vub.ac.be/MSTT.html).

To me this cybernetic world view represents one expression of an *objective narrative, scientific constructivism* that purports to resolve the paradox of self-organization.

Eros-chaos, Eros-order collaboration. According to the Metasystem Transition Theory,

> [evolutionary] Self-organization is a process where the organization (constraint, redundancy) of a system spontaneously

> increases, i.e., without this increase being controlled by the environment or an encompassing or otherwise external system (http://pespmc1.vub.ac.be/SELFORG.html).

I present my understanding of this theory in terms and ideas presented earlier in this paper. First of all, there is a hierarchal view of the second law of thermodynamics wherein the cybernetic version of it includes and therefore can be reduced to the classical or statistical mechanics versions of it. The cybernetic version proclaims the universality of the mutuality of Eros-chaos and Eros-order. Eros-chaos, which is the universal drive described by the classical version of the second law, leads to some degree of breakdown of the order of a system. This order may be described in terms of constraints on the interactions among particles making up a system. For example, a system of hydrogen gas is made up of hydrogen molecules each composed of two hydrogen atoms. The two hydrogen atoms in a hydrogen molecule are like members of a married couple. Theoretically each member is not free to date other people, and likewise, each hydrogen atom is not free to chemically interact with other atoms. The breakdown of hydrogen molecules releases electro-chemical potential energy stored in the bond between two hydrogen atoms. Some of the released energy may do work, but there always will be some of this energy expressed as a heat event. Thus, the overall potential of the system to do work has decreased; so the entropy, which measures the <u>inability</u> of a system to do work, has increased.

Eros-chaos that breaks down some constraints in a system opens up new possibilities for new particle interactions. This sets in motion a random "trial and error process" of particles "attempting" to form new associations involving new chemical bonds. Many new associations are not stable, and therefore they do not persist. The new associations that are stable do persist. The characteristics of any new stable association provide the totally internal criteria for rejecting many possible new associations and selecting others. The result of this selection process is a

new set of constraints on the particles of the system, and correspondingly, the system has taken on a new order. *I designate this selecting process as Eros-order*. Order represents the cohesive, stable unity of the system that metaphorically may be said to represent the *system's self*. Eros-chaos breaks down an old system's self into the chaos of many new possible particle associations. Eros-order is the selection process that converts the chaotic system into a new system's self equal to a new order. Overall this is a creative process involving the *collaboration* of Eros-chaos and Eros-order to produce a new system's self, characterized by new negative entropy equal to new information. Thus, overall this Eros-chaos, Eros-order collaboration is the process of self-organization that in this case may also be called evolution.

Example. Eros-chaos involving high energy flux drives a mixture of hydrogen and oxygen gases far from equilibrium to the higher entropy state of positive hydrogen ions and negative oxygen ions. There are many possible new associations between these ions. Eros-order representing quantum mechanics rules for new stable associations selects water molecules to emerge as the new order defined by new constraints equal to new information. The old order does not contain this new information. Rather, the new information only becomes manifest after Eros-chaos opened up new possibilities. The new order emerged from the chaos of the old order. Water implies hydrogen and oxygen but not vice versa. If we never observed this creative event, we would not be able to predict water as an outcome. After observing the emergence of water as an outcome, we can set up the situation where the same self-organization will be repeated. But this emergence of new information is time asymmetric. The particular Eros-chaos, Eros-order collaboration involving high energy flux at non-equilibrium and quantum mechanics rules insures that stable water molecules will form rather than hydrogen and oxygen molecules. Water at room temperatures is very stable and will not breakdown into hydrogen and oxygen. In

general those types of self-organizing processes that are equal to an evolutionary process produce the hierarchy of new order that implies the chaotic old order from which the new order emerged.

Three Defining Features Of Any Evolutionary Process

First Feature: Hierarchal Order, Chaos, New Order Process

The first feature is complex in that it requires a narrative, scientific, constructivism perspective on the one hand, and on the other hand, it applies to non-evolving systems such as any machine as well as "self-organizing," evolving systems. The order of a potential in nature and the order of machine work may be represented by the same mathematical-physical symbols defined in terms of units of energy, but the orders are *qualitatively* different. The autonomous potential in nature is not a potential to accomplish a particular task; it has no machine purpose. It only becomes a "task potential" when it collaborates with an appropriate energy coupler. This collaboration is neither determined by the physical laws that specify the potential in nature nor by the laws that specify the operation of an energy coupler. There are an indefinite number of ways the collaboration can occur resulting in the efficiency of the machine varying from low to high. An autonomous potential in nature does not contain or in any way refer to this idea of collaboration. Therefore, order of a potential in nature and the order of machine work are fundamentally different. That is, a machine has an organization pattern that can convert flux into work done by a machine. Machine work, the new order created by a machine, implies a potential in nature, but, as stated earlier, the old order does not imply the new order. Thus, machine creativity is a hierarchal order, chaos, new order process. The word "hierarchal" in this statement means that the new order includes a modified old order. However, one cannot make

this statement from a scientific constructivism perspective. This hierarchal creative process, which also involves the mutuality of Eros-chaos and Eros-order, only can be understood in this way from an objective, narrative, scientific constructive perspective (Pribor 2005, 73-780).

Second and Third Features

The second and third features are exhibited by evolutionary creativity but are not exhibited by machine creativity. Machines only produce information transformation *external* to the machine structure. Any mechanistic or machine understanding of aspects of nature, such as perceiving an ecosystem only as a homeostatic machine (one version of the Gaia hypothesis) or perceiving any organism only as a homeostatic machine, at best only gives an external, narrative, scientific constructivism understanding that implies that evolutionary creativity cannot occur. Thus, many practicing scientists or science teachers exclusively committed to mechanistic or machine theories of nature, consciously, for example, Albert Einstein, or unconsciously deny the idea of creative evolution. However, internal, narrative, scientific constructivism sees the chaos phase of a systems narrative as breaking up some old collaborations in the system thereby exposing new possible collaborations between parts of the system and/or new possible collaborations between the system and its environment. This leads to the *second feature described as trial-and-error coupled with a selection process*. The various possible collaborations are tried and criteria of stability intrinsic to nature select those collaborations that are sufficiently stable to survive and reject those collaborations that are not sufficiently stable. *The third feature is the context or environment in which the trial-and-error process is occurring further selects those stable collaborations that continue to survive* in the environment of the evolutionary process. For example, a system consisting of positive hydrogen atoms and negative oxygen atoms near

equilibrium will transform to hydrogen and oxygen molecules. The same system far from equilibrium will transform to water molecules.

Metaphorical Understanding of the Three Features of an Evolutionary Process

An evolutionary process always begins with a particular order. This implies that a system that does not have a stabilized order over time, such as a human who always is in chaos, cannot express evolutionary creativity. For example, some of the "flower children" of the 1960s countercultural revolution could never transform to some expression of adulthood. Iraq totally destabilized after the U.S. invasion in 2003 to 2007 cannot evolve to a stable democracy. Bringing an overwhelming military force to stabilize a very imperfect and thus partially chaotic democratic Iraq government could open the possibility for a transformation to a more adequate democratic government. The order of a patriarchal marriage can exemplify the three features of an evolutionary process. If the wife rebels against patriarchal dominance by the husband, the marriage goes into chaos that may lead the husband to give up his commitment to patriarchal dominance. A new order would be a new kind of marriage involving dialogue about shared responsibilities and decisions. Evolution to this new order would require trying out different ways of relating to one another and of course consciously selecting those that work and rejecting those that do not work. The values of the society in which this transformation is occurring will further select the new ways the husband and wife will relate to one another.

Market Capitalism Metaphor for Understanding Biological Evolution

Evolution is the process of transformation that also may be called individuation. Individuation begins when the Order of a system degenerates to Chaos that exposes new possibilities. Actuation of some of these possibilities leads to a New Order with emergent properties. An economic unit such as an individual human, a business, or a society, survives in a market, which is an environment for buying and selling. An economic unit exhibits Order when the market is *suitable* for the unit's survival and the unit is *adapted* to the market. For example, if a business is making a profit for an extended period of time, then two things are simultaneously true. First, the people running the business are doing what is necessary to be successful. In particular, they are making the necessary adjustments to changes in the market, such as changing their product or service to meet the needs of their customers (they are maintaining the homeostasis of the business). Second, the market is such as to enable a well-run business to survive. The most well-run, aggressive, refrigerator company could not survive if it depended on selling refrigerators to native Eskimos living in igloos in Alaska. These two ideas represent what may be called the *mutuality of economic unit and the market*.

An analogous understanding of the same two ideas applied to biological evolution gives us the *mutuality of a species and its environment*. A species, which is a population of individuals with similar traits, reproduces from one generation to another a similar life pattern and participates in a network of interactions with other species and with its physical-chemical environment. This complex network of interactions is an ecosystem in which the species is analogous to a business that exhibits a two-fold mutuality with its environment; the environment is analogous to the market. In a stable ecosystem the environment is suitable for the survival of the species. This means that the species life pattern contains mechanisms by which it can survive on a moment-to-moment basis and reproduce its life pattern. Furthermore, the species

life pattern exhibits an array of homeostatic mechanisms by which the species can adapt to changes in its environment. In summary, in a stable ecosystem, the environment is suitable to the continued survival of a species and the species is continually making adaptations to changes in the environment.

Chaos occurs when there is an irreversible disruption of the mutuality of the economic unit and the market. Continuing with the example of evolution of a business, we may conclude that the market has changed beyond the capacity of the business to adjust to this change; or for some reason – usually poor leadership – the business has decreased its effort to adapt to a changing market. The Chaos of the disruption of the mutuality of a business and the market simultaneously leads to the loss of one niche and the emergence of new possible niches in the market. Some businesses, like the Ford Motor Company in the 1980s and IBM in 1991, will – if guided by CEOs with vision coupled to strategic plans that carryout the operationally defined goals of the vision – undergo extensive restructuring that enable them to occupy a new possible niche in the market. The restructuring involves trying strategies for occupying a particular new niche and selecting those continually modified strategies that lead to financial success in occupying that niche. Alternatively, the business will try strategies to fit into several different niches and select those that produce the greatest success. Other businesses will not make the necessary restructuring and therefore will not survive in the changed market. In effect, the *market selects* those businesses that will be successful and prosper over those that will go out of business. This idea of the market selecting those businesses that survive over the many other businesses that do not survive represents the second and third features of an evolutionary process. Competition is a central theme in evolution. With respect to evolution of business, there will be a few winners and many losers.

Biological evolution begins with an irreversible disruption of the two-fold mutuality of a species and its environment. On the one hand, this disruption can lead to the species becoming extinct, but, on the other hand, a central idea of biological evolution is that chaos opens up new possible collaborations that can lead to the emergence of a new species life pattern. Reproduction of a species leads to mutations, that is, changes in genetic information, to some offspring in each generation. Most of these mutations have negative survival value but some have positive survival value that generates new species-environment mutualities in the changing environment. The occurrence of mutations in each generation in a sequence of several thousands of generations and the elimination of negative mutations represents the second feature of any evolutionary process. Some of these new mutations will confer onto individual organisms expressing them a greater chance to survive and reproduce the emerging new species life pattern containing them. In a long sequence of generations of a population of individuals representing a particular species, the number of individuals in each new generation having the superior species-environment mutuality will increase and the species will become more stable, and correspondingly, the number of inferior mutualities will progressively decrease. In this ongoing process of increasing superior mutualities (and decreasing inferior mutualities), which is called *natural selection*, the environment selects the new mutualities that progressively are incorporated into the species life pattern. This transformation to a new species life pattern more adapted to the environment is called *species adaptation*. The accumulation of many species adaptations in the evolving species eventually leads to a species life pattern that is radically different than the life pattern just before the species began to evolve. The difference is so great that the new pattern is classified as a new species, and the overall process of accumulating species adaptations is called

species transformation. The species adaptations and species transformation represent the third feature of any evolutionary process.

Natural selection is the core idea of biological evolution. As many species become extinct, a few by natural selection over thousands of generations will accumulate traits that represent a "restructuring of the species life pattern." These restructured species survive in that they establish a New Order represented as a new, species-environment mutuality. With respect to biological evolution most species that have emerged in the history of the biosphere have become extinct. The current network of interacting species in the biosphere represents the winners.

Transcending Fragmentation Of Knowledge

Fragmentation of Knowledge

In a dialogue between two scientists about fragmentation of knowledge, *David Bohm* points out that scientific thinking split off problems into specialized disciplines that ignore the wider context of these problems that would show their interconnections. This type of thinking has been very successful in predicting, controlling and manipulating things so as to produce short-term solutions to problems. This divide and conquer type of thinking, according to Bohm in 1987, is becoming our culture's general approach to life as a whole. *David Peat* agrees and comments that the success of science solving more and more problems has a cost, which is more and more specialization and fragmentation to the point where rational thinking in general is disconnected from any vision that would give it meaning. *David Bohm* responds by claiming that we need wisdom in order to transcend this science-generated fragmentary attitude toward life. Our

serious problems in the 20th century (and now in the 21st century) are due to "lack of wisdom" rather than a lack of knowledge (Bohm and Peat 1987, 11-14) and (Pribor 2005, 394).

Bohm and Peat acknowledge that in order for modern science to emerge, thinkers of the (third) Enlightenment had to break from the dogmatism of the Catholic Church. But then after science became institutionalized and embedded in Western culture, it developed its own kind of dogmatism called *positivism*. According to positivism, even though no one can attain to absolutely true knowledge, any knowledge gotten by means other than the scientific method is invalid and not legitimate. But according to Bohm and Peat, at a level just below consciousness, scientists cling to the hope of scientific knowledge evolving toward absolute truth expressed as their theories are literally, approximately true. For example, this attitude is expressed as: "Evolution is not a theory; it is a fact." Therefore, scientists strongly defend against any attempt to point out limitations of science so that this way of knowing can be incorporated into a holistic spiritual vision. Accordingly, any attempt to defeat scientific dogmatism in the present climate of science dominating American culture will fail (Pribor 2005, 397). Bohm and Peat proclaim:

> What is needed is some new overall approach, a creative surge … that goes beyond the tacit and unconscious ideas that have come to dominate science. Such a novel approach would, however, involve questions about the nature of creativity and what, if anything, will help to foster it (Bohm and Peat 1987, 24-25).

Ervin Laszlo (and the Principia Cybernetica Project described earlier) proclaims that in the 1980s there has emerged a new evolutionary perspective representing patterns of change studied by all the natural sciences. Now systems scientists are applying this perspective to the social sciences, psychology, and the humanities so that it is

> [T]he most interdisciplinary theory ever created by humans. It marks a new era in scientific thinking [responding to the need pointed out by Bohm and Peat for a revisioning of science]. Now the creative process of universal evolution is becoming conscious of itself as expressed in individual humans and in human societies (Laszlo 1987, 9-10).

According to Laszlo, this new evolutionary perspective is a positivistic way of knowing that is totally based on empirical observations rather than introspection and the subjectivity of philosophy, and it proposes logical, conceptual models that are testable and that describe the same pattern – the evolutionary process – expressed in all realms of the universe. As a result, it is now possible to advance a grand evolutionary synthesis (GES) based on unitary and mutually consistent concepts derived from the empirical sciences (Laszlo 1987, 18). In other words, all we need is scientific constructivism; there is no need for narrative constructivism involving metaphorical, conceptual insights.

Dogmatic Integration of Diverse Disciplines

The realism synthesis. *Realism* takes the view that reality consists of independent objects that are interrelated by cause and effect interactions. Realism assumes that each object contains forms that together make up its nature or essence. Reality is said to be knowable (intelligible) as a result of humans being able to abstract forms manifest in concrete experiences into mental concepts that "exist" in the mind. An individual mind then constructs patterns of cause and effect relations among objects each represented in the mind by one or a nexus of forms. When the interrelated objects are known by direct intuition to exist or are assumed to exist, the mental constructed pattern is subjective knowing of reality. Language consists of symbols that represent mental concepts that represent forms or natures manifested by reality. Language also consists of symbols that designate the existence or non-existence of objects. As a result of language, two or

more people can communicate their subjective knowing of nature. Shared knowing by language communication thus is the process of converting subjective knowing into objective knowing. When objective knowing is purified by the logical principles of induction and deduction, then it is said to be absolutely or approximately true. Thus, the realism perspective allows several possible types of subjective knowing that are mental constructs. Subjective language knowing, that is, conceptual knowing, may be objectively true or approximately true or objectively false. Subjective non-language knowing, that is, non-conceptual knowing associated with purely intellectual insights or with feeling insights cannot be communicated to others and therefore can never be said to be objectively true or approximately true or false. One may speculate, however, that the subjective, non-conceptual knowing that guides a person to carryout objectively acknowledged great accomplishments, such as raising children to be responsible, moral, and psychologically healthy persons, is in some sense true (Pribor 2005, Preface).

Thomas Aquinas (1225?-1274) proposed that the "independent objects" are interrelated by the analogy of being, which proclaims that every being is different than all other beings but are similar and interrelated according to the following metaphorical analogy: each finite, created being exists in a particular, unique way, but they all "have" or "express" existence, represented by the word, *esse*, where all the diverse esse are metaphorically similar. The subjective mind-self is able to "see" this similarity but is unable to specify it further by means of language. Rather each being also has an *essence* that determines the particular, unique way each finite being exists. The essence may be thought of as consisting of diverse *forms* some of which the subjective mind-self can know by abstraction. Thus, all finite beings that humans can directly experience are intelligible as a result of the analogy of being and of abstraction that produces mental concepts. The resulting subjective knowledge is absolutely true. Language

representation of the analogy of being and mental concepts produces absolutely true, objective knowledge that humans can share. However, only a relatively few humans have the mental acuity to attain most if not all subjective truths. Therefore, some institution, which in the Medieval era was the Catholic Church, dogmatically proclaimed objective truths that all people were required to believe rather than know for themselves. The end result of this realism-analytical perspective is that all educated humans shared a unified knowledge of reality represented by diverse theoretical and practical disciplines that are integrated by metaphysics-theology that also provided dogmatic interpretations of "revealed truths." The being we call God is immanent in all finite beings and therefore is accessible to humans objective knowledge or to a few via subjective knowing. God also IS transcendent in that IT is not limited by the collection of finite beings. Rather, god is "I am that I am" meaning that IT is pure existence in which essence and esse are identical. Even if there were no finite beings, God still would be pure existence.

The systems integration of knowledge. The systems new evolutionary perspective claims to overcome the modern fragmentation of knowledge, but this is a sham and is banal. Laszlo forbids introspection and the subjectivity of philosophy, but he proclaims the evolutionary process is becoming conscious of itself in individual humans. This means that individual humans are conscious of themselves being conscious of the evolutionary process. How can an individual experience this consciousness other than by introspection? Indeed how can any individual be aware that he/she exists other than by introspection? By eliminating all subjectivity, which is the major flaw of scientific constructivism from its first emergence, the all-inclusiveness of the systems synthesis removes the most important aspect of many disciplines. This especially can be appreciated with respect to music. A piece of music can be

objectively represented by a set of symbols written on a piece of paper. But can this objective understanding of music really represent music when such "knowledge" does not elicit in us subjective feelings and pleasure? What systems scientists and scientists in general fail to acknowledge is that subjective insights and the feelings associated with them represent the more important aspect of being human. The systems perspective is an explicit extreme version of reducing flesh and blood individual humans to automatons that can be controlled and manipulated by dictatorial leaders. Such a view not only destroys constitutional, liberal democracy, it readily can lead to the atrocities of Hitler's Nazi Germany and Stalin's Russia.

Transformation of Laszlo's Type of Vision Via Narrative Constructivism

A systems version of scientific constructivism leads to all the natural sciences being able to describe evolutionary processes occurring in each aspect of reality they study. A narrative, scientific constructivism enables these scientists to realize that the method of knowing by which they create their theories of evolutionary processes is itself an evolutionary process. In fact, this insight can be extended to proclaim that scientific constructivism as carried out by individual scientists or a group of scientists is an evolutionary process. With the aid of metaphorical, conceptual knowing, narrative, scientific constructivism may be differentiated into each of the diverse ways of knowing associated with each discipline. Such a differentiation would include, for example, narrative, historical constructivism, narrative, psychological constructivism, narrative, philosophical constructivism, and narrative, theological constructivism. Each type of *narrative constructivism* would specify the starting point for creating their constructs. Some method would specify certain types of empirical information or subjective insights that become objective by virtue of a group of thinkers who share the metaphorical, conceptual understanding

of the subjective insights. The latter is what Thomistic philosophers did and still do with respect to the analogy of being. Also, each narrative constructivism would specify the criteria by which a theory is judged to be valid or not. Again, of course, each person using a particular narrative constructivism type of knowing should realize that this subjective or group collaboration for creating a new understanding of reality is itself an evolutionary process, which, of course, implies that the way knowing and the models it generates can evolve to higher levels of sophistication. This narrative constructivism of knowing avoids dogmatism such as found in Medieval realism philosophy. At the same time, this constructivism transcends the fragmentation of modern science. This approach allows for diverse points of view, and yet it avoids total relativity such as found in existentialism, avant-garde modernism, and the current postmodern perspective. It does so by providing a method by which a community of thinkers can reach consensus about the validity of a particular model.

Transformation of Education

Opposition between liberal education and science. At the beginning of the nineteenth century the ideal of a liberal education dominated the high schools and colleges in the United States. Though science did not fit in very well to this ideal, science still was subordinate to it. However, in the mid 1800s the emergence of thermodynamics and the theory of machines corresponded with an intensification of industrialization associated with market capitalism. This led to science progressively having greater influence in Western societies. This greater influence began to focus on the fundamental opposition and eventual conflict between liberal education and modern science. Liberal education has its roots in Aristotelian philosophy, especially as this philosophy was modified and incorporated into scholasticism generated by the metaphysics-

theology of Thomas Aquinas. In particular, the integration of diverse ways of knowing and the values of liberal education depended on realism coupled with dogmatic, metaphysical, analogical thinking described earlier. This grand synthesis in education put forth a required collaboration between subjective, analogical knowing and objective, logical, conceptual knowing.

The emergence of positivistic science, finalized by Newton's theory of motion, depended on nominalism. For physicists beginning in the 16th century, for biologists in the mid 19th century who committed to Darwin's theory of evolution and others who rediscovered Mendel's theory of genetics, and for modern thinkers influenced by science, conceptual, language knowing is a social phenomenon manifested in individual humans. This social phenomenon is called *nominalism*. Each member of a group of humans points to the same aspect of the world that each person perceives. No two perceptions are the same, but they all agree that a particular arbitrary symbol will thereafter represent this aspect of nature and represent the overall pattern by which each individual perceives it. Thus, the diverse subjective perceptions of a particular aspect of the world are focused into a single, conceptual, objective representation of that aspect. In this manner what we now call ordinary language knowing emerges and via language communication represents how a society views itself and nature (Pribor 2005, 258).

The modern theory of metaphor as summarized by George Lakoff, (Lakoff 1993, 202-251), expands the philosophy of nominalism. Metaphor emerges after the emergence of conceptual knowing and then profoundly enhances the power of ordinary language. Contrary to classical theories of language, metaphor is not a type of linguistic expression; rather, it is a higher level of knowing than elementary conceptual knowing. Lakoff defines metaphor as a general mapping across conceptual domains. That is, metaphor is a higher level of conceptual

knowing in which one conceptualizes one mental domain of experience in terms of a different mental domain of experience that is "seen" to have in some ways the same internal structure.

Thus, metaphorical knowing is a higher order of elementary conceptual knowing. All conceptual knowing, in turn, is a mutuality between self-conscious subjective, episodic knowing and objective knowing involving social consensus. Each human experiences aspects of the world episodically. These experiences are in some way represented and stored in the "knower." They are existential perceptions that can be associated with an arbitrary symbol, that is, a word. Individuation to the polar self corresponds to the "knower" "seeing" similarities among several perceptions which then become a domain of similarities in the mind. Individuation to the persona self in a civilized society enables the "knower" to conceptualize these similarities, which is to say that the knower creates and stores a pattern called a *concept*. Thereafter, each existential perception that relates to the same domain of experiences will be "seen" as exhibiting this pattern. Correspondingly, all these existential perceptions will be seen as identical. When this occurs, the knower sees each experience as an instance of a concept. The individual, existential uniqueness of each experience is sacrificed for the sake of seeing patterns; that is, conceptual knowing. At this point conceptual knowing still is a subjective process occurring within the individual knower. However, growing up in a civilized society always leads to some – perhaps most if not all – of these subjective concepts to be associated with a word in an artificial symbolic language. Many humans may have similar subjective concepts. The consensually agreed upon word associated with these similar, subjective concepts represents all of them as if they were identical, thus producing objective, conceptual, language knowing of the world. This objective knowing within the context of civilized society leads each knower to see

the world as a "whole" made up of relatively autonomous "parts." The parts are things or events that are conceptually known.

Metaphorical knowing is the process of "seeing" similarities between two domains of experience, each represented by a concept. The knower starts out seeing that the two concepts, that is, the two patterns, are quite different. Metaphorical knowing emerges when one sees similarities between the two patterns and then formulates a new higher-level concept, the metaphorical concept that represents the similarities between the "lower level concepts." The metaphorical concept then leads to new insights in the following way. While one sees similarities between concepts A and B, one may know a lot about A and not much about B. The metaphorical concept is the pattern: S*ome structure relationship in A may be thought of as the same as some structure relationship in B.* As a result of the metaphorical concept, one understands aspects of B in terms of what one knows about A (Pribor 2005, 258-259).

Thus, nominalism as adopted by the first emergence of science and more especially as adopted by current scientific thinking, rejects realism and its associated analogical, metaphysical thinking. As a result, from its first emergence science was a misfit in traditional Western culture. As its influence began to overtake traditional Western attitudes and values, it produced a crisis that led in about 1885 to the emergence of avant-garde modernism (Pribor 2005, 420-427). The subjective knowing of avant-garde modernism, especially as formulated by Nietzsche, in a different way than science, also rejected realism and analogical, metaphysical thinking. By the early 20th century liberal education began to move from the foreground to the background. Liberal education continued to recede until the complete victory of science over it in1958. According to D. A. Kolb, Jerome Bruner, at the conference on education in 1958, introduced Piagetian theories of cognitive development to the final stage of logical, conceptual thinking as

the most important way of knowing (Kolb 1984, 139-140). As a result, the U. S. educational system adopted scientific thinking as the most important way of knowing. Up to the early 1960s, a non-scholastic general education version of liberal education was thriving in the top higher education schools in America, (Bell 1966), but after the countercultural revolution of the 1960s, "liberating general education" degenerated into mindless general education with no unifying themes and no vision of what it means to be educated (Bloom 1987). The so-called liberating general education in America proclaimed by colleges and universities now is a sham, and high school and college education in America is a degenerating farce that is costing ever more money while providing less and less benefits to society.

Scientific new collaboration between subjective and objective knowing. While rejecting the realism's collaboration between metaphysical, analogical thinking and logical, conceptual thinking, science of the (third) Enlightenment created a new kind of collaboration of subjective and objective knowing. The genesis of Newton's theory of gravity exemplifies this new collaboration. Newton, like everyone else in his day, had a metaphorical understanding of the empirical pattern of falling down. Newton used his newly created calculus to describe Kepler's three laws of motion of celestial bodies. Newton derived a law describing a planet circulating around the sun that indicated that it continuously accelerated toward the sun. From his newly created laws involving contact force, he concluded that there is a gravitational force at a distance causing "the planet to tend to fall" toward the sun. Newton's metaphorical understanding of this gravitational force led him to think that the moon circulating the earth also is continuously falling toward the earth. Further metaphorical thinking led Newton to claim his celestial gravitational force also is the action between the earth and any mass object close to the surface of the earth. This force action leads to the pattern, "falling down." But then, again based on

metaphorical thinking, Newton proposed that his gravitational force is action between any two mass objects located anywhere in the universe. This totally unfounded hypothesis was not validated until 1789 when Cavendish demonstrated with his torsion balance that two lead balls do exert a gravitational effect on each other (Toeplitz 1963, 168-169).

Newton's story represents how scientific constructivism generates any valid scientific theory. The subjective aspect of metaphorical knowing generates awareness of empirical patterns that then are first described by a metaphorical model. Then, this metaphorical model is described by an objective, logical conceptual theory – usually a mathematical model – that can be experimentally tested for validity. Once the theory is validated, it usually is understood as a totally objective way of understanding nature; that is, any conscious affirmation of subjective knowing is rejected. This conscious attitude is extended to the teaching of science in high schools and colleges. A minority of superior students, especially those at the elite schools, struggle to gain a logical, conceptual understanding of the validated objective theories. However, most students, initially anyway, memorize the technical terms and the theories without understanding any of them. Then these students will forget them after each of the three or four times having to "learn" them.

The fourth enlightenment: transforming education. The first enlightenment was the transformation of the metaphorical, conceptual thinking of the pre-Socratic philosophers to the logical, conceptual knowing of Socrates, Plato and Aristotle. The classical Greek thought rejected any reliance on traditional mythology, that is, pagan religions, and on metaphorical, conceptual thinking (Pribor 2005, 310-313). The second enlightenment, which began with the mystical, heroic creativity of the Jesus cult (Pribor 2005, 332-336), and of Sufism associated with the vision of Mohamed, the Prophet, culminated in Thomas Aquinas' grand synthesis

described earlier. In this vision subjective analogical thinking collaborated with logical, conceptual thinking to produce philosophical theories. In the emergence of scientific constructivism representing the core of the third enlightenment (usually referred to as the Enlightenment) the subjectivity of metaphorical, conceptual knowing generated empirical patterns that could be represented by logical, conceptual theories that, in turn, could be experimentally tested for validity. Thereafter, valid objective scientific knowing rejected all subjective insights except those that produced empirical patterns that eventually are represented by validated scientific theories. As science began to dominate American education in the 20th century, students were taught to develop objective, scientific thinking, that is, "critical thinking" and avoid the subjectivity of metaphorical, conceptual thinking and of feeling insights.

The fourth enlightenment began with the insights of Nietzsche as "corrected" and expanded by Heidegger. The first section of this paper describes the evolution of fourth enlightenment involving the transformation of scientific constructivism first to narrative, scientific constructivism that then differentiated into diverse kinds of narrative constructivism, each appropriate to a particular discipline. Narrative, scientific constructivism enabled humans to realize that the evolutionary process, defined by three features, describes scientific constructivism thinking as well as evolutionary-developmental process studied by the various natural sciences. Narrative constructivism describes the thinking of all those who embrace this approach to knowing as an evolutionary process and describes the evolutionary process expressed by various aspects of reality as studied by diverse disciplines.

The impact of this emergence of the fourth enlightenment on education could be that it transcends the fragmentation of knowledge produced by scientific constructivism and postmodernism. It now becomes possible to construct educational programs for high schools and

colleges that have unifying themes that inculcate values and that define what it means to be educated. The unifying themes include: (1) the evolutionary process as exemplified by all the disciplines and by all artistic creativity; (2) the evolutionary process as exemplified by human, spiritual transformation including but not limited to mystical transformations associated with various religions; and (3) narrative constructivism that comprehends diverse expressions of the evolutionary process and leads to a radically new vision and teaching style called narrative constructivism. *Narrative* c*onstructivism* is *creative learning* in which the learner "constructs" a subjective understanding of abstract ideas in terms of his/her personal experiences. A constructivism teaching style involves describing/presenting abstract ideas in terms of metaphorical concepts, analogies, and stories. A metaphorical concept, analogy, or story represents a pattern that each person can subjectively understand. When this pattern is superimposed onto an unknown, abstract idea, then each person "seeing" this superimposition will begin to understand the unknown abstract idea in terms of his/her personal experiences. A textbook for teaching *Survey of Biology*, designed for non-science majors, exemplifies this approach to creative teaching-learning (Pribor 2004).

The narrative constructivism also may point to other unifying themes such as: (1) operation of any machine and machine structure of various systems and institutions; (2) homeostasis including discussion of negative feedback as opposed to positive feedback; (3) mechanistic thinking; (4) mystical, heroic creativity; (5) epigenesis (developmental process); (6) ecology and the mutuality of ecology and evolution; (7) communication in relation to coupling and collaboration and distinguishing between information and non-information; (8) individuation and hierarchal levels of self-consciousness; (9) creative, mindful dialogue; and (10) various representations of an ultimate SOURCE such as creator God, Gia Goddess, Being (described by

Heidegger), Brahman (of Hinduism), Emptiness (of Buddhism) all of which are associated with various religions and/or types of spirituality. The values of constructivism education include a modified description of the values associated with the traditional view of liberal education. The definition of what it means to be educated would include the ideas that one would see interconnections among diverse disciplines, would develop personal creativity and would develop the ability to participate in creative dialogue.

Subjective Validation Of One's Personal Evolution

Overview

The subjective experience of one's personal evolution has the same three characteristics as described in the beginning of this paper, but there are five added features. First, the Order, Chaos, hierarchal, New Order process is better represented by a *Life, Death, Rebirth* process. Life metaphorically represents a person's state of mind that gives him/her meaning and/or ability to accomplish many if not all desired goals. When life's meaning and/or goal achievement irreversibly declines, such as loss of a loved one, divorce, loss of a job that cannot be replaced, failure at school, then Life goes to psychological Death that has both negative and positive aspects. The negative aspect, of course, is that this personal chaos is painful producing great anguish. Of course we all prefer order to the anguish of chaos; so the first challenge of personal evolution is to choose to confront our personal reality that our perspective no longer is working.

If one can confront and endure this personal suffering for an extended period with an attitude of openness to new possibilities, then the positive aspect of chaos emerges. One begins to see new possibilities that, when activated, lead to a New Order, that is, a Rebirth of psychological stability, meaning and goal achievement. The Second new feature is that often

what enables a person to endure the mental anguish is an existential Faith leading to belief in an ultimate SOURCE identified in various ways such as Creator God or the VOID of Buddhism. The Third new feature is that the person in the midst of psychological Death has the courage and commitment to attempt to activate each new possibility that emerges and/or try over and over again the same possibility. The Fourth new feature is that the individuating person continues to have the Faith-Hope, courage, and commitment to activate a new possibility in spite of all past failures. Thus, the third and fourth new features are the conscious choosing the *trial and error* aspect of evolution. The Fifth new feature overlaps with the fourth feature. One must have patience combined with Faith-Hope to have courage and commitment to activate new possibilities again and again until the changing environment becomes a context in which the activated possibility becomes a success that leads to the emergence of a new order. This is a Resurrection of a person in the extended chaos of repeated failures. This Rebirth process, of course, is the *natural selection* aspect of evolution. The ultimate test of one's Faith-Hope is that one goes to biological death with the firm belief that his/her heroic efforts will benefit humans after his/her biological death.

Some Examples

The personal evolution of an alcoholic to a recovering alcoholic dramatically exemplifies this process. The first major challenge to this process often is a major barrier to a transformation. It takes some alcoholics many years before they finally acknowledge that they have a problem they cannot control. They fear not being in control; so they delude themselves into thinking they have some control. Alternatively, a drinking pattern is a kind of perverse order that is preferred over the chaos between the old order and the transformation to a new

order. Sometimes – perhaps often – it takes a flash personal enlightenment such as: "I could have died because of being drunk;" or "If I continue this drinking, I am going to die!" The next major challenge is to give up personal control or to give up blaming other people for their problem(s) or to expect some significant other to solve their problem(s). This is where alcohol anonymous (AA) is so helpful to many drunks. A group of alcoholics tell their wrenching stories of acknowledging the drinking problem and of turning themselves over to a "higher power," what I call the ultimate SOURCE, even if one has had bad experiences with one or more religions or if one does not *believe* in the existence of any higher power. This second challenge is not about belief, though religious or philosophical belief in a creator God may predispose a person to do what is necessary.

What is necessary is Faith-Hope, which is Trust. *Trust* is not belief, which is a knowledge-based attitude of the mental-self. Trust is the act of the Will to abandon reliance on the mind-self and in so doing give oneself over to that which cannot be "seen" by the mind-self. As a result of this "giving oneself over," the person enters the mystical realm of "no-self" implying "no-knowing," that eventually produces a "no-self awareness" of a *transcendental knowing*. What enables a person to carryout this humanly impossible act? After experiencing this new kind of knowing, one may be able to say that it was Grace from the ultimate SOURCE. Particular circumstances may dispose a person to be open to receive this Grace. The AA meetings for many people provide the supportive environment for one to become temporarily vulnerable and open to receive this Grace. And the wrenching stories may lead one to say: "Hey, this higher power stuff worked for these guys; I'll give it a try." Here is where the third and fourth features come in. Sometimes after only one try, which nevertheless must be repeated over and over again in the context of ongoing attendance of AA meetings, one experiences a

preliminary "seeing" associated with Trust. Sometimes one must make the leap of Trust many times before this preliminary "seeing" emerges. As the preliminary "seeing" continually is experienced over time, Trust becomes more permanently established in a person. In some cases this leads to a personal belief system. However, Trust must be continually renewed because it remains radically different from any belief system.

As one continually renews Trust and shares this personal experience with others, comforting them, the experience of Resurrection from personal chaos begins to occur. Now one chooses to be in the AA community and may change his/her participation in other relevant communities. Moreover, as one becomes more enlivened by Grace, one repels some former "friends" and attracts new associations and events that support one's new life of no-drinking. Eventually one sees himself/herself as a transformed person. This is a joyous time, but *the joy poses a great danger*. The transformation to a new order is not the end of one's life story. The new order becomes the necessary possible old order because it breaks down and requires a rebirth to yet another new order. Evolution is on going. No new order is permanent; sooner rather than later it will degenerate. For the "recovered alcoholic" this means a reversion to an out-of-control drinking pattern. A born-again alcoholic is empowered, but if one does not regress to drinking again, the danger is that a person may believe he/she *has power* rather than being continuously empowered by Grace through Trust. The power comes to one through choosing no-mind-self associated with no-mind-knowing. Therefore, a person who believes his/her mind-self has power becomes a born-again fool. Such a person will tend to have an inflated self-confidence in one's abilities and not look at one's life situation in a detached, non-biased way. When the course of events go against one's wished-for expectations, one may remain in a state of denial just as he/she did before acknowledging a drinking problem. As

described in Greek and Shakespearean tragedies, the hubris (the alcoholic believing he has power) of the hero leads to his tragic downfall. If the hero is in a position of power/leadership, many others suffer the consequences of his foolish hubris. A whole nation plus millions of others may be taken down.

I am not now and I never have been an alcoholic. I am not now and I never have been an Evangelical, born-again Christian. I have experienced many major life transformations including developing hubris that required another terrible transformation. I have learned about the inner workings of evolution from these personal experiences that supplemented my scientific understanding about the external expression of evolution. All of this has embolden me to claim that, while each personal transformation is unique in being tied to an individual life history brought to a crisis in a particular set of circumstances, all such transformations exhibit a metaphorically similar pattern. This insight leads to the ironic insight that many religious people, such as some Evangelical born-again Christians, who have undergone such a transformation, reject all the ideas associated with the scientific theories of evolution. The irony is that while personally experiencing an evolutionary process, they are unable to acknowledge and understand a metaphorical, conceptual description of this process. Another irony parallel to this one is that while intelligent, rational people acknowledge and understand rational descriptions of evolutionary processes, they are unable to apply this understanding to personal crises in their own life stories or to religious people describing their own personal transformations. The key to understanding these parallel ironies is that many, if not most, people today do not embrace the necessary collaboration between metaphorical, conceptual thinking and logical, conceptual thinking, which, of course, further implies a collaboration between subjective and objective thinking.

Conclusion

A metaphorical, conceptual understanding of universal creativity, as presented in this paper, represents an objective, scientific narrative description of evolutionary processes leading to the emergence of life on earth and to further evolution of the biosphere. As described in the "Introduction," this scientific narrative can be translated into Richard Dawkins' version of biological evolution as presented in the 30th anniversary edition of *The Selfish Gene*, published in 2006. Each instance of an evolutionary process exhibits three characteristics: (1) order, chaos, hierarchal, new order process (2) that is achieved by trial-and-error selection (3) of possible, stable and most efficient and most cooperative collaborations intrinsic to a particular environment. Evolution defined by these three characteristics applies to self-organization, called *individuation*, of any system and to many types of human creativity including leadership, parenting, teaching, experiential learning, all forms of artistic expression, athletic competition, market place capitalism, personal transformations, and narrative constructivism in all the disciplines of knowledge. Narrative constructivism is a sequential process starting with a vague, everyday language understanding of an empirical process or subjective insight that then is represented by the construction of a logical, conceptual model that can be validated by some set of consensually agreed upon criteria. The validated model then is converted into an objective narrative that can be understood by any layperson and that relates to other narratives constructed by other disciplines. This narrative always can be reduced to the precise, technical language of a particular model for purposes of practical applications.

Fragmentation of American education and society mirror one another and reciprocally bring deterioration to both. As Bill Gates noted in a Los Angeles Times article, 2005, in terms of

pragmatics, “Today only one third of our students graduate from high school ready for college, work, and citizenship.” And across the country about 40% of students entering college need remedial work in one or more subjects especially writing, mathematics, and science. Universities, in turn, are graduating progressively less technically trained people to enter the work force to continue to make the U. S. competitive in global markets. Influential leaders, such as Bill Gates, recommend that high school and college students be required to take more science, mathematics, and technology courses. However, this approach does not solve the technical education problem while exasperating a more serious social problem. Science education, as represented by science textbooks used in high schools and introductory courses in college, demands that students memorize with little understanding abstract ideas presented as pieces of information. Young adults, still influenced by the not totally repressed imagination and creative energy of childhood, on the one hand, are open to experiential understanding abstract ideas and, on the other hand, are intensely stimulated by video games, the internet, and personal high technology gadgets. To these students, science taught as information to be memorized: will be irrelevant to their experiential exploring minds, will be quickly forgotten and therefore not build toward “science literacy,” and will eventually lead students, forced to memorize words rather than understand ideas, to shut down the inquiring mind with respect to formal education, especially with respect to science and mathematics – thus *teaching science merely as pieces of information damages the mind*. Finally, young minds force-fed information not only will not see interrelations among diverse ways of knowing, they will tend to be closed to any spiritual vision, such as the spiritual vision of democracy.

As an aspect of the fourth Enlightenment, leaders in postmodern societies must guide the transformation education. They must insist on all teachers and textbooks adopting to some

degree narrative constructivism, which was described earlier, and which is a generalized version of narrative, scientific constructivism described in the first part of this paper. Richard Dawkins used this approach extensively in writing *The Selfish Gene*, which continues to inspire and teach laypersons and scientists after thirty years. The narrative constructivism understanding of universal evolution described in this paper points to a transformation of general education or of traditional liberal education to what may be called transdisciplinary education. *Transdisciplinary education* can construct a virtually infinite number of courses showing unifying themes among diverse disciplines and among other types of human creativity. Such an approach would include discussing values and diverse ways of knowing, especially in introductory courses. Transdisciplinary education also would facilitate developing personal creativity and the ability to participate in creative dialogue.

Objective, narrative constructivism can talk about values and spiritually, such as Dawkins' view of humans having free will to transcend the dictates of "selfish genes," but it does not require postulating an ultimate SOURCE, for example, the creator God hypothesis. Various objective narratives, such as scientific narratives, can be reduced to logical, conceptual models that guide humans exerting control over how they live. For example, probability models describe trends in nature that can guide strategic planning even on a day-to-day basis. This possibility has enticed many humans to believe they have control over their lives. This is a profound illusion. As dramatically portrayed in the movie, "Bable," for unknowable reasons one's life suddenly may degenerate into total chaos where one's current knowledge does not guide any strategic planning for overcoming the chaos. This is where a subjective, narrative, constructivism understanding of universal creativity comes into play. Some people in some terrible crises may be able to remain calm, endure the chaos, and eventually see possibilities that

are individually selected to produce a new order emerging from the chaos. However, most people, especially in the most terrible crises, only can endure the chaos long enough to participate in creating a new order by a *willed faith* – not a belief – in an ultimate SOURCE such as God. Thus, the objective narrative understanding of universal evolution described in this paper provides the basis for constructing a subjective, narrative understanding of creativity and personal transformations in all aspects of one's life. In particular, the understanding of universal evolution described in this paper provides the basis for collaboration between science and non-fundamentalist, non-religious or religious spirituality.

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