The Expression of Purpose in Evolution

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> (T)hen begins the activity of the Second Logos, the Builder and Preserver of forms. His activity is spoken of as the Second Life-Wave, the pouring out of Wisdom and Love—the Wisdom, the directing force, needed for the organization and evolution of forms, the Love, the attractive force, needed for holding them together as stable though complex wholes. When this great stream of Logoic life pours forth into the fivefold field of manifestation, it brings with it into activity the Monads, the Units of Consciousness, ready to begin their work of evolution, to clothe themselves in matter.[1]

Those of us who subscribe to a metaphysical world-view take for granted that creation is purposeful. The world is the vehicle through which the life of a Logos is expressed, and the evolution of the kingdoms of nature simply reflects the unfolding consciousness of that Life. But we also have to recognize that *teleology*, the theory of purpose, is not a popular term among mainstream scientists and philosophers. For the last 150 years, consensus opinion has insisted that the world and we evolved more or less randomly from simpler states of being. We can observe evolution and learn from it, but it is meaningless to ask why it occurred.

However, there is evidence that humankind has reached a turning point in its intellectual development and that the notion of purpose will soon find more general acceptance and even scientific proof. This essay traces the rise, fall, and rebirth, of teleology. It also suggests that a rational model may soon emerge which can explain the mechanism of purpose in the universe. The basic form of that model is already beginning to take shape.

Rise and Fall of Teleology

Until 1800, few people who considered the issue at all doubted that the universe served the purpose of a divine creator. Aristotle coined the work *telos*, the “end” or “purpose” for which something was made or done. Our word *teleology*, the theory that natural processes or occurrences are purposeful, comes from that root. Often, but not always, a belief in cosmic purpose was accompanied by faith in divine benevolence or optimism that conditions would improve over time. But whether or not conditions improved, changes were attributed to direct intervention. God micromanaged the universe, sending an earthquake here and a deluge there, pestilence here and a prophet there.

The notion of divine purpose was reexamined when physical laws were discovered governing celestial and terrestrial mechanics, but it was not immediately abandoned. In fact Isaac Newton saw in those eternal, immutable laws of motion an expression of the splendor and majesty of a rational god. The universe was a giant mechanism, like a clock, but it was a wonderful clock. Newton himself believed that the universe, albeit ordered and predictable, was kept ticking by a “perpetual miracle,” whereas his contemporary, Gottfried Leibniz, scoffed at that suggestion. An omnipotent god could wind up the clock once and then could sit back and watch it run. Leibniz’ views influenced the 18th century Deists who acknowledged a creator but—in a break with the notion of micromanagement—doubted whether he retained much day-to-day interest in his creation. Nevertheless, both Leibniz and René Descartes saw God as the “fountainhead and guarantor of the total rationality of the cosmos.”[2]

In 1816, Newton’s eternal, immutable cosmos was called into question by scientific studies of heat. Sadi Carnot suggested that the clockwork universe was running down. Physical matter was becoming more and more random and less able to do productive work. Forty-nine years later, Rudolf Clausius expressed this principle in the Second Law of Thermodynamics, which stated that, *entropy*, a measure of molecular disorder, was continuously and inexorably increasing.[3] These theoretical developments came too late to stop the issuance of the first English patent of a perpetual-motion machine in 1635. However, the Patent Office was undeterred by the publication of Clausius' work, and by 1903, some 600 such patents had been issued.[4]

Information theory subsequently interpreted the Second Law to relate the increase of entropy to a decrease in information. The universe was becoming less ordered, less valuable, and less *meaningful*. This downhill slide cast doubt on God's perfection, if not his purpose.

By the 19th century, teleology was drawing its primary strength from biology. Naturalists were convinced that, if a clockwork universe needed a designer, living creatures with ingenious organs, such as the eye, certainly needed one. In 1802 William Paley noted the multitude of living species and observed that each seemed to be ideally suited to its environment. Who else than an intelligent creator would so thoughtfully place polar bears in the Arctic, lions in equatorial grasslands, and fish in the sea?[5] And if the lower lifeforms provided evidence of divine purpose, philosophers asked, how much more convincing was the evidence provided by man? Man—the epitome of design—was created in God's image, placed in a world replete with flowers, butterflies, and "all things bright and beautiful," and promised a blissful hereafter in the Father's House.

However, God did not receive credit for the natural world for long. In 1859 Charles Darwin and Alfred Wallace showed that the diversity of biological species could be explained by random mutation and natural selection.[6] Soon thereafter, Darwin made the crucially important suggestion that man himself was descended from a nonhuman ancestor.[7] Darwin never claimed that natural selection was the *sole* mechanism governing biological evolution and he never totally rejected J. B. Lamarck's contention that learned characteristics could be passed to offspring.[8] Furthermore, Darwin did not consider himself to be an atheist.

But random mutation and the ethical neutrality of reproductive advantage appealed to teleology's adversaries, and arguments for and against purpose became entwined in science-versus-religion polemic. Thomas Huxley and others seized upon evolution research to support the atheist position.[9] The origin of life continued to be a stumbling block, but this obstacle began to crumble in the 20th century. Scientists explored the possibility that life emerged spontaneously from inanimate matter. Electric discharges in the laboratory, simulating lightning, could produce elementary proteins from organic chemical soups.

For a while, the Big Bang suggested a specific beginning in time and a specific act of creation, and numerous theologians saw in it a vindication of the Genesis story. In fact, the notion of the Big Bang was first proposed by a churchman, Canon Georges Lemaitre. But a closer study of the mathematics led James Hartle and Stephen Hawking to the conclusion that a specific beginning could not be identified; that time became fuzzy as one tried to extrapolate it back to zero.[10] Furthermore, there were suggestions that the Big Bang itself might be a random event. Perhaps the universe and all its inhabitants could have created itself—in some kind of chance occurrence, albeit of gigantic proportions.

These various scientific discoveries had far-reaching implications. David Hume and Immanuel Kant rejected metaphysical issues like purpose as irrelevant. It is meaningless to ask "why?" Science should be based solely on observation and experience. Even though living organisms evolved from "lower" to "higher" forms—an observation that contrasted oddly with the 2nd Law of Thermodynamics—teleology was neither necessary nor relevant. Natural processes should be understood in terms not of purpose but of *mechanism*, and, almost by definition, mechanisms supporting teleology are unobservable. Concepts such as purpose, design, or beauty in nature are nothing more than subjective, sentimental value judgments. By the latter part of the 20th century, mainstream science had effectively buried teleology. As one commentator put it: "The proponents of teleological theories, for all their efforts, have been unable to find any mechanisms—except supernatural ones—that can (support their position). The possibility that any such mechanisms can exist has virtually been ruled out…"[11]

The implications of the 2nd Law of Thermodynamics have also been debated widely. It appears that we, the product of random mutations, live in an increasingly random universe which is destined to decay into, what Hermann von Helmholtz called, a "heat death" of infinite entropy. Any progress is temporary and illusory. There is no basis for hope and little motivation for effort. In fact, any expenditure of effort can only accelerate the rise of entropy and bring forward the universe's demise. Jeremy Rifkin advised a drastic reduction in energy consumption—which in turn would constrain the kind of economy and technology we can enjoy—while consoling us only with the thought: "There is great beauty in the Entropy Law. It guides us through the cosmic theater with a bittersweet authority."[12] We may as well sit back, relax, and wait for inevitable annihilation. Teleology was replaced by cynical pessimism and nihilism.

Complexity and Progress

Teleology is dead, long live teleology. Scarcely had the nihilists begun celebrating the purposelessness of their brave new world, questions began to arise that cast doubt on their position. Important questions concerned the specificity of the natural order. When we look around, we do not see the widespread disorder that the 2nd Law of Thermodynamics would lead us to expect in a universe 15 billion years old. Rather, we see a surprising degree of order. Stars, galaxies, crystals, biological species, economies, languages, civilizations, and new knowledge are there for all to see.

Cosmologists found that, although the physical universe probably developed from a primeval fireball, the fact that it evolved into what we observe today was highly fortuitous and depended critically on certain initial conditions. For example, Roger Penrose has estimated that, in order for the universe to develop in accordance with the 2nd Law, conditions in the Big Bang had to be fine-tuned to a precision of one part in

$$10^{10^{123}}$$

—a number which far exceeds the number of elementary particles in the universe.[13] If the universe created itself in a random event, the fall of the dice was "lucky" beyond belief.

Similarly, biological species could have evolved by random mutation, but today's species would have taken much longer to develop than the life of the planet permitted. Huxley's monkeys have not had time to type their Shakespeare sonnet.[14] Other critics of natural selection have questioned how complex organs or language could have evolved so rapidly. The more highly developed a system is, the less likely that it could have evolved solely by random causes.

A theory that has come to the rescue, at least partially, is complexity theory. On the other hand, complexity theory may be the key to reestablishing purpose a teleological basis for evolution. Complexity theory's roots go back to the 1930s, with the work of Andrei Kolmogorov and Gregory Chaitin.[15] But it owes its modern form to the pioneering work of John von Neumann. The theory has developed rapidly over the last few decades by absorbing a number of related disciplines: Claude Shannon's information theory,[16] Ludwig von Bertalanffy's general systems theory,[17] Norbert Wiener's theory of cybernetics or control systems,[18] and Ilya Prigogine's studies of nonlinear dynamics or "chaos."[19]

Complex systems of interacting components can become *self-organizing*, developing much faster than would be possible through unaided random permutation. Crystals, avalanches, and tornadoes are examples of self-organizing structures, and so are biological and economic systems. Self-organizing structures may exhibit randomness, but still they belong to recognizable structural families. No two snowflakes are the same, but everyone knows that they are snowflakes. Members of structural families are “favored” over the myriad of other possible systems that might have developed in the same environment—systems corresponding to Darwin’s “intermediate forms” or missing links. In an environment where crystals can form, many more develop to a high degree of perfection than would be expected in an unconstrained random process. Complexity restricts the diversity of forms while accelerating their development.

In self-organizing structures entropy *decreases* locally. Such complex systems do not violate the 2nd Law of Thermodynamics because they absorb energy from their environments, and the overall level of entropy increases. However, even a local reduction in entropy—or increase in order—opens a crack in the otherwise gray sky of the universe’s future. We may well be heading for ultimate heat death, but some very interesting developments may take place in the meantime. As Prigogine noted:

> This is something completely new, something that yields a new scientific intuition about the nature of our universe. It is totally against the classical thermodynamic view that information must always degrade. It is, if you will, something profoundly optimistic.[20]

One of the tenets of complexity theory is that new, unforeseen properties can emerge at successive levels of increasing complexity. For example, the chemical properties of a molecule are qualitatively different from the properties of its atomic components and could not be predicted from them, no matter how much was known about atoms. Similarly, the behavior of living organisms could not be predicted from the properties of their chemical elements. To take an extreme example, no amount of knowledge of quarks and leptons could be used predict MTV and the stock market. The emergent properties are spontaneous manifestations at the particular level of complexity. But are these emergent properties just another class of random phenomena, or are they guided or directed in some manner by some agency of purpose? To answer this question could provide the key to determining whether, where, and how purpose enters into evolution. Two different types of evolution will be examined with the question in mind.

Complexity in Biological and Economic Systems

The first is the evolution of biological species that we have already considered. Darwinian natural selection clearly is a powerful explanatory model, and it has dominated 20th-century academic biology. Genetic mutation provides intergenerational diversity—however slight—and reproductive advantage selects and amplifies variations which are most adapted to their environment. Over time, the theory of natural selection has had to be modified to accommodate symbiotic relationships among species and even genera and to accommodate group reproductive advantage. Occasionally, species—like bees—succeed through cooperative, even altruistic, behavior among individuals, some of whom may enjoy no sexual advantage. However, natural selection does not imply progress. Biological species become more adaptive, but not “better.” Development of the human brain was a random process that simply gave us a competitive advantage over less developed animals.

Complexity theory helps here, because it envisions the progression from “lower” to “higher” states in a hierarchy.[21] A value judgment is implied, even if it is nothing more than the assertion that “more complex” is superior to “less complex.” Systems at each level retain the properties of “lower” levels and add their own emergent properties. As noted earlier, complexity theorists insist that the emergent properties are novel and cannot be predicted from information about the lower levels of a system. The work of Henri Bergson was prophetic in this regard. In the early years of this century, he argued that evolution is creative, like the work of an artist.[22] It is driven by an underlying mechanism, but the mechanism cannot fully explain the direction taken, and the outcome is unpredictable. The work of art cannot be comprehended until it is completed.

The second type of evolution considered here is the growth of economic markets. Adam Smith considered the behavior of markets accessed by large numbers of buyers and sellers, all of whom are motivated solely by self-interest. The quantity of goods that sellers are prepared to supply and the quantity that buyers demand are both influenced by price. A stable or "natural" price emerges when supply and demand are in balance. Individual buyers and sellers have no interest in the larger picture, but, as Smith noted, over time, a perfectly competitive market approaches an equilibrium state in which the allocation of economic resources is optimized. In his words, it is as though an "Invisible Hand" guides the market.

History shows that the Invisible Hand has not always served as a perfect instrument of resource allocation. But alternatives, such as central planning, have almost uniformly failed. A free market can efficiently meet the day-to-day needs of communities, cities, and nations for goods and services, whereas socialist systems have resulted in scarcity, poor quality, and dissatisfaction. Furthermore, global economic markets have succeeded in bringing together people who, for centuries, were divided by bitter religious, ideological, or nationalistic antipathies.

The Invisible Hand operates somewhere between the bargaining underlying individual transactions and the macroeconomy, just as progress in biological systems enters somewhere between an animal's sexual potency and the ecosystem. The complexity present in aggregates of large numbers of individual actions builds a bridge between small-scale random, self-serving actions and large-scale benefits. How does complexity do this? What property of complexity is able to bring about changes that merit a value judgment? What is the link between complexity and teleology?

To gain necessary insight, we need to examine a property that has been observed in self-organizing systems—the tendency to form feedback loops. Feedback brings about an exchange of energy and information between a system and its environment, enabling the system to become self-regulating or *autopoietic*. A familiar example of a self-regulating system is a thermostatically controlled heating system. The system monitors the temperature and turns itself on and off to maintain a near-constant temperature in a room. Information from the system's output is fed back to control its input. Fritjof Capra discusses such feedback loops and sees in them the basic mechanism of life. He argues that to be considered alive, from a systems standpoint, an entity must be bounded, self-organizing, and autonomous, although it will exchange energy and information with its environment. Its pattern of organization will be relatively durable, while allowing for growth and in some cases offering the potential to adopt new, more complex patterns. Autopoietic feedback can be detected in living systems ranging from single cells to human beings and even to the planetary *Gaia*. They are the basic elements in cellular automata and other models of artificial life.

Evolution—of biological or economic systems—occurs, as we have seen, in the aggregate of large numbers of interacting units. These aggregates are sufficiently complex to support the emergence of feedback loops which channel energy and information and which may result in self-regulation or autopoiesis. In other words, processes develop in the macro-systems that resemble those in living organisms. The economic system or ecosystem literally "takes on a life of its own." Its emergent properties may be qualitatively different from properties of the individual units that comprise it. And, in keeping with Henri Bergson's comment about the "creativity" of biological evolution, they would not be predictable on the basis of component behavior. Life is inherently creative and capable of unexpected turns.

Accordingly, it would be no surprise to find that purposeful behavior might exist at the macro level but not at the micro level. "Macro," in this context, may refer to a system as large as the planet—or larger. Animal species and national economies are components of the world "system," whether or not we choose to call it Gaia. On the other hand, complexity, autopoiesis, and a resemblance to living systems are not sufficient to demonstrate purpose. The neo-Darwinists purport to have shown that that life emerged from inanimate matter and evolved in a random process. Similarly, the claim that economies benefit from the Invisible Hand may be just another unjustified value judgment, like Paley's praise for the beauty of butterflies.

Evolution and Mind

However, Fritjof Capra goes further in his study of complexity. In what, perhaps, is his greatest contribution, he characterizes the behavior of autopoietic systems as *cognitive*, "the process of knowing." "(T)he organizing activity of living systems… is mental activity. Mind—or, more accurately, mental process—is immanent in matter at all levels of life."[23] Even an inanimate self-regulating system, like a thermostat, is *conscious* of its behavior in relation to the environment. If Gaia, or for that matter the universe, is a Mind, the conceptual jump needed to accept purpose is much shorter. A cognitive entity can express purpose or intent.

The cognitive process may be internal or external to the system. But if purpose is to be global and able to guide a system such as the economy to benefit humanity as a whole or the planet, some external processes must be at work. If an external cognitive process is involved, one final link is needed to bridge the gap between the nonphysical and the physical: a mechanism for the transmission of force. Mainstream science, from the time of Descartes, has been reluctant to admit the possibility of nonphysical-physical interaction, although scientists are more open now because electromagnetic fields are not "physical" in the ordinary sense of the word. And mental-physical interaction has been demonstrated in laboratory experiments in psychokinesis.[24] Scientists who believe in the mind, as distinct from the brain, are looking for a mechanism to explain how a thought can translate into a physiological action, like raising one's arm. One suggestion is that quantum-level phenomena may be involved.[25]

Complexity theory suggests another possibility. An important conclusion reached by complexity theorists is that self-organization takes place in a narrow domain to which Chris Langton gave the now-famous characterization: "the edge of chaos."[26] In a completely stable environment, too much energy would be required to create the necessary interactions among components, while, in a completely random environment, too much energy would be wasted. In this highly fluid—and creative—domain, systems are often close to bifurcation points where they could go in two or more different ways, like a teetering rock. At a bifurcation point, very little energy is needed to push a system in a desired direction. Interestingly, a similar sensitivity may exist in superimposed quantum states where the collapse of the wave function determines which state will be observed.

If mind can exert any force at all on physical systems, one of the best places for it to act would be at bifurcation points in near-chaotic systems. This possibility could usefully be explored in psychokinetic experiments. In any event, a planetary or cosmic mind, much more powerful than ours, could have appreciable influence, and the strong amplification associated with the bifurcation points would increase its potency still further.

Conclusions

Mainstream science rejects a teleological view of the world in favor of the random evolution of physical and biological systems. This consensus position has received support from two main sources. One is the success with which evolutionary models have explained and unified observations in biology and cosmology. The other is the failure to identify a mechanism by which a nonphysical agency capable of expressing purpose could influence physical states. If nonphysical agencies, such as consciousness or thought, can exert any physical force at all, that force seems to be too small to produce significant change.

However, these two pillars of support are crumbling. Serious gaps are emerging in random evolution models, particularly in relation to the specificity of the biological and cosmological systems that we observe. There simply has not been time for these systems to have evolved into what they are today. The more highly organized a system is, the more unlikely it could have developed solely by random processes.

Complexity theory describes important aspects of physical, economic, and biological systems, including properties and behaviors that emerge only at a given level of complexity. Increase of complexity and the emergence of previously unsuspected properties are precisely what we mean when we talk about evolutionary "progress." Interestingly, the feedback loops that can develop in complex systems are thought to be essential ingredients of both life and cognition. Living systems are aware of their environment and their relationship with it. The most important conclusion from complexity theory, from the standpoint of this essay, is the existence of bifurcation points where the properties and behavior of systems can change abruptly under the influence of minute forces. Bifurcation points, which exist "on the edge of chaos," provide opportunities for mental forces—individual or global—to exert measurable influence.

The notion that purpose, acting through some individualized or global cognitive process, can impress itself on physical, biological, or economic systems has far-reaching implications. Perhaps the Cartesian division between physical and nonphysical phenomena is finally coming to an end. If the world's intellectual leaders can accept that the universe is purposeful, nobody's life will be the same again.

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[1] Annie Besant. *A Study in Consciousness*. Theosophical Publishing House, 1904, p.45.
[2] Paul Davies. *The Mind of God*. Touchstone, 1992.
[3] W. H. Cropper. "Rudolf Clausius and the Road to Entropy." *American Journal of Physics*, vol. 54 (1986).
[4] Graham P. Collins. "There's No Stopping Them." *Scientific American*, October 2002, p. 41.
[5] William Paley. *Natural Theology: or Evidences of the Existence and Attributes of the Deity*, 1802.
[6] Charles Darwin. *The Origin of Species*, 1859.
[7] Charles Darwin. *The Descent of Man*, 1871.
[8] J. B. Lamarck. *Philosophie zoologigue*, 1809.
[9] T. H. Huxley. *Man's Place in Nature*, 1863.
[10] See Stephen W. Harking. *A Brief History of Time*. Bantam, 1988.
[11] Ernst Mayr. "Evolution." *Evolution*. Freeman, 1978.
[12] Jeremy Rifkin. *Entropy*. Bantam, 1980.
[13] Roger Penrose. *The Emperor's New Mind*. Oxford, 1989.
[14] To illustrate the concept of random evolution, Huxley argued that six monkeys equipped with typewriters could, over millions of years, type a Shakespeare sonnet by chance. However, recent calculations suggest that all the monkeys that ever existed could not have typed even one line of a sonnet. See, for example, David Frost, *The Philosophical Scientists*, Dorset, 1985.
[15] Gregory Chaitin. *Information, Randomness and Incompleteness,* Houghton-Mifflin, 1987.
[16] Claude Shannon and Warren Weaver. *The Mathematical Theory of Communication*, Univ. of Illinois Press, 1949.
[17] Ludwig von Bertalanffy. *General Systems Theory*, Braziller, 1968.
[18] Norbert Wiener. *Cybernetics*. MIT Press, 1961.
[19] Grégoire Nichols and Ilya Prigogine. *Exploring Complexity*, Freeman, 1989.

[20] Quoted in Jeremy Campbell. *Grammatical Man*, Touchstone, 1982.
[21] Some writers are offended by the term *hierarchy*, on the grounds that it implies dominance and subordination, and prefer *holarchy*. This author agrees with Ken Wilbur (*Sex, Ecology, Spirituality*. Shambhalla, 1995) that, although the word sometimes may have been abused, "hierarchy" is essentially neutral with respect to dominance and connotes nothing more than a systematic ordering.
[22] Henri Bergson. *L'Évolution créatrice,* 1907.
[23] Fritjof Capra. *The Web of Life*. Anchor, 1996.
[24] See, for example, Edgar Mitchell, (Ed.) *Psychic Exploration*, Putnam, 1974.
[25] Roger Penrose. *Op. cit*.
[26] Chris Langton. "Computation at the Edge of Chaos: Phase Transitions and Emergent Computation." *Physica* D 42, 1990.