THE PHYSICS OF CREATIVITY AND THE CREATIVITY OF EVOLUTION

„The creation of the universe is usually envisaged as an abrupt event that took place in the remote past. It is a picture reinforced both by religion and by scientific evidence for the 'big bang'. What this simple idea conceals, however, is that the universe has never ceased to be creative"

Paul Davies

As the contemporary physicist, Paul Davies (1988), notes above, creativity is ongoing within the history of the physical universe. Creation did not end at the beginning, however conceived; it was only getting started. Especially in the West, we do not see the physical cosmos as a creative (or selfcreative) reality. We follow a Newtonian model of the universe in which matter is dead and inert, simply pushed and pulled about by physical forces (Lombardo, 2006a); and/or we accept the Judeo-Christian explanation that God created all the forms of nature at the beginning of time.

Yet, contrary to both Newton and *Genesis*, within contemporary cosmology and evolutionary theory, the universe is generally viewed as possessing an ongoing history of creative and emergent realities. Further, creativity within nature appears (to a degree) to be cumulative, building upon what existed before but equally transcendent in manifesting novel realities that go beyond what existed before. In essence, natural evolution is a creative process, ongoing, cumulative, and yet transcendent.

If indeed this view of natural creativity is correct, then creativity need not involve an intelligent or purposeful agent generating it (contradicting the divine source theory of creation). Moreover, the foundational dynamics and underpinnings to creativity in humans (intelligent and purposeful agents) exist within nature itself; creativity is not something unique in humans. What, indeed, do we know (or at least surmise) regarding the creative process in the evolution of nature. By the time of Darwin, nature was no longer seen as a stable reality created by God as it presently is. Rather nature, both biological and geological, was understood to be dynamical with a long history of change. Even the heavens no longer seemed stable or eternal as most ancients believed (Green, 1959). For Darwin, living species evolve and hence emerge through a gradual process of natural selection of variable offspring. Biological evolution of the new is driven, at least in part, through adaptation to environmental conditions which change over time as well. Further, there is both becoming and passing away, for species disappear (go extinct) as well as emerge. Further still, living forms are interconnected, provoking each other into change, through competition over resources and niches; there is a clearly a selfprovoking quality to creation within nature. Based on such natural processes, out of simple beginnings emerge a great variety and complexity of biological forms. This envisioned evolutionary process involves both cumulative growth and progressive differentiation.

More recently, Stephen Gould and Niles Eldredge add to this vision of creative biological evolution the idea that the emergence of new species is often relatively sudden (in geological terms) rather than slow and steady as Darwin envisioned it. There is "*punctuated equilibria*". Species may stay relatively unchanged for extended periods and then holistically and quickly transform; the process is not slow and piecemeal. Regardless of what instigates these sudden shifts a frequently cited cause is dramatic environmental change creative evolution is Gestalt-like and relatively quick.

The contemporary biologist Lynn Margulis further proposes that biological evolution at times has involved symbiosis, where distinct species integrate forming more complex species. She contends that this is how eukaryotic cells (cells with nuclei) emerged, through a coming together of prokaryotic cells (cells without nuclei). Nature, in fact, is filled with symbiotic relations and interdependencies. Hence, the creative evolution of the new is not simply driven by competition; there is also integration among simpler forms, whether the forms physically merge or simply develop reciprocal living arrangements. What emerges out of such symbiotic integrations is something new and creative. Self-organization in natural evolution is a theme that frequently shows up in contemporary open systems or complexity theory. Progressively, especially over the last century, principles of self-organization and evolution have been applied not only to biology but to nature as a whole. What Darwin was describing in his theory of biological evolution was just one piece of a general cosmological process.

For Ilya Prigogine, diverse types of natural systems evolve through self-organization. Natural systems undergoing increasing turbulence can jump upward to higher levels of organization and complexity; hence, the expression "order out of chaos" is used to capture a fundamental dimension of evolutionary change within nature. Connecting with ancient themes, chaos is viewed as a prelude (even necessary condition) for creation.

Pulling together Darwin and Prigogine, Stuart Kauffman argues that the evolution of life involves both competition and natural selection, and self-organization–an integrative, complicating process.

Moreover, for Kauffman the emergence of more complex natural forms is to a great degree unpredictable; the universe is filled with novel, emergent realities that cannot be predicted from simpler constituents that preceded them. In arguing for such a view, now framed at a cosmic level, Kauffman aligns himself with the great twentieth century philosopher Alfred North Whitehead who stated that "*The ultimate metaphysical ground is the creative advance into novelty*".

Anticipating Kauffman, the philosopher, J. T. Fraser (1978), also weaves together the themes of order and chaos in his explanation of the ongoing evolution of nature, as well as similarly arguing that new levels of complexity cannot be predicted or understood relative to lower levels of complexity. A further common theme found in such theories is that creation occurs at the interface of order and chaos, of structure and flow.

Building on such ideas, Kevin Kelly argues that self-organization is a result of the interaction of many parts within a system, rather than the coordination of parts from some top-down command center. There is no need for a singular creator orchestrating or generating the emergence of the new. Hence, there is an unpredictability and "*out of control*" quality to this pluralistic process of interactive self-organization.

As we move into the new Millennium, the theory that the cosmos as a totality has evolved through a succession of creative jumps in complexity has become fundamental to the scientific picture of nature. Distilling the essence of this vision, Harold Morowitz presents a list of twenty-eight creative steps in the emergence of everything within the universe each step conceptualized as more complex than preceding steps. This comprehensive panorama of the ongoing act of creation includes the successive emergence of stars, galaxies, chemical elements, solar systems, planets, geospheres, cells, animals, mammals, hominids, tools, agriculture, cities, and philosophy. Creation is not guided or orchestrated from above in this process; creation is not planned out; creativity is intrinsic, pervasive, and essential to the dynamics of the universe itself. What's more, it is an adventure, filled with novelty and unpredictability, rather than a foregone conclusion.

To recapitulate: cumulative growth; ongoing change and creativity; differentiation and syntheses; relatively sudden holistic transformations; chaos, unpredictability, novelty, and adventure; and self-organization all show up as fundamental themes in the modern scientific vision of creative evolution in nature. But there is more. The art movement of Futurism, which emerged early in the twentieth century, began its manifesto with the following words: "*We want to sing the love of danger, the habit of energy and rashness...We declare that the splendor of the world has been enriched by a new beauty: the beauty of speed*". And indeed, the pace of change in contemporary times seems to be speeding up, perhaps to the point of a mad frenzy.

Many argue that evolution has been accelerating across the great panorama of cosmic time and that what we see in our contemporary world (how quick things move, how fast things change) is simply a manifestation of this general natural phenomenon of accelerative evolution. As Murray Gell-Mann notes, evolution in the cosmos has moved through roughly six fundamental levels of increasing complexity and organization: the physical quantum; physical macro-gravitational; chemical; biological; cultural; and technological. For Gell-Mann (1994), each stage brings with it a faster, more complex process for further evolution. That is, evolution is evolving, and each stage finds a way to speed up the process of more change, more increasing complexity and order. To drive this basic point home, when scientists and historians are asked to identify key advances in the history of life on the earth, they generally agree on which constitute the most important jumps forward and, if plotted on a graph, the key identified jumps are coming closer and closer together in time.

As Toffler (1971) and Gleick (1999), among others, point out, we live in an era of accelerative change for Gleick, it is "*the acceleration of just about everything"*. Though Kurzweil (1999, 2005) primarily applies the "*Law of Accelerating Returns*" to the exponential growth of information technology, the same basic principle can be applied to all forms of change in human society. Innovations (ideas and inventions) feed back into the entire social-technological system, stimulating further changes and developments. Growth is a positive feedback loop; creation feeds on creation, hence, the accelerative growth of natural evolution. As David Christian points out, the most salient and dramatic fact within recent human history that seems responsible for the rapid evolution of society and technology is the accelerative growth of human innovation. Humans, coupled with their technologies, are highly creative beings–an advanced expression of the creative evolutionary process in nature and it is our evolved creative capacity that is generating the accelerative speed of change within our world.

References:

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