

STUART KAUFFMAN**Emeritus Professor - Biochemistry, The University of Pennsylvania, United States**

Stuart Alan Kauffman is an American theoretical biologist and complex systems researcher. Kauffman graduated from Dartmouth in 1961, was awarded the BA (Hons) by Oxford University in 1963, and completed a medical degree at the University of California, San Francisco in 1968. He held appointments at the University of Chicago 1969-1973, National Cancer Institute 1973-1975, and the University of Pennsylvania from 1975 to 1995. Kauffman held a MacArthur Fellowship, 1987–1992, has an Honorary Degree in Science from the University of Louvain, and was awarded a Gold Medal of the Accademia Lincea in Rome.

Kauffman proposed the self-organized emergence of collectively autocatalytic sets of polymers for the origin of molecular reproduction in 1971. Such sets have been made recently. He proposed that the complexity of organisms results both from self-organization and Darwinian natural selection. He invented, 1967, models of Boolean networks as simplified genetic circuits. His hypotheses stating that cell types are attractors of such networks have found experimental support. Kauffman rose to prominence through his association with the Santa Fe Institute. Kauffman holds the founding broad biotechnology patents in combinatorial chemistry.

Dr. Kauffman also holds the founding patent on a newly discovered "Poised Realm" that hovers indefinitely between quantum coherence and classicality. His co-published "No entailing laws, but enablement in the evolution of the biosphere", shows that evolution is not law entailed, as is physics. Recent work on the Mind-Body problem, Quantum Mechanics and a new dualism, Res potentia and Res extensa are in his book, "Humanity in a Creative Universe".

Dr. Kauffman has published over 300 articles and 5 books: *The Origins of Order* (1993), *At Home in the Universe* (1995), *Investigations* (2000), *Reinventing the Sacred* (2008), and *Humanity in a Creative Universe* (2016).

Beyond physics: The emergence and evolution of life

The emergence and evolution of life is based on physics but is beyond physics. Evolution is an historical process arising from the non-ergodicity of the universe above the level of atoms. Most complex things will never exist. Human hearts exist. Prebiotic chemistry saw the evolution of many organic molecules in complex reaction networks, and the formation of low energy structures such as membranes. Theory and experiments suggest that from this, the spontaneous emergence of self reproducing molecular systems could arise and evolve. Such “collectively autocatalytic systems” cyclically link non-equilibrium processes whose constrained release of energy constitutes “work” to construct the same constraints on those non-equilibrium processes. Cells yoke a set of non-equilibrium processes and constraints on the energy released as work to build their own constraints and reproduce.

Such systems are living, and can propagate their organization with heritable variations, so can be subject to natural selection. In this evolution, these proto-organisms emerge unprestatably, and afford novel niches enabling, not causing, further types of proto-organisms to emerge. With this, unprestatably new functions arise. The ever-changing phase space of evolution includes these functionalities. Since we cannot prestate these ever new functionalities, we can write no laws of motion for this evolution, which is therefor entailed by no laws at all, and thus not reducible to physics. Beyond entailing law, the evolving biosphere literally constructs itself and is the most complex system we know in the universe.