



# CERN Colloquium

**SPEAKER:** Stuart Kauffman (FRSC, U Vermont, Santa Fe Institute, Tampere U. Technology)

**TITLE:** **"The current status of work on the origin of life"**

**DATE:** Thu 19/05/2011 16:30

**PLACE:** Filtration Plant

## ABSTRACT

Work on the Origin of Life is poised to converge onto a fourth phase and, many of us hope, success. The first phase concerned prebiotic synthesis of the small molecules, amino acids, nucleotides, lipids and others, essential for life and spanned some forty years. The second overlapping phase was inspired by the symmetric of the DNA or RNA double helix, presumed that life must necessarily be based on some form of template replication of one strand by ligation of free nucleotides to create the second strand, melting of the two strands and cycling again. Spearheaded by L. Orgel, but with many others, this effort has, to date, failed. The third phase begins with the discovery that RNA molecules can act as enzymes, and posited the RNA world, in which RNA molecules dominated. This has led to slightly successful efforts to evolve an RNA sequence able to template replicate itself. Current success is an evolved ribozyme able to do so for 14 nucleotides.

The forth phase is converging around four ideas: 1) liposomes, hollow bilipid spheres obtainable from lipids in water, can grow and divide. We now widely hope that these can serve as "containers" bounding proto-cells. 2) Sources of free energy, from pyrophosphate to proton pumps. 3) A minimal metabolism in a "messy" systems chemistry which supplies the small amino acids, nucleotides and lipids for proto -life. 4) Collectively autocatalytic sets of polymers, peptides, RNA, or other, which achieve molecular reproduction in dividing liposome containers, hence also open ended evolution. At present, a 9 peptide collectively autocatalytic set has been constructend, achieving catalytic closure, and demonstrated beyond doubt that the DNA or RNA double helix is not needed for molecular reproduction. In addition a two membered DNA autocatalytic set has been constructed and two two membered RNA ribozyme autocatalytic sets have been selected from a large RNA library.

The author, in 1971 and 1986 proposed a theory in which the emergence of collectively autocatalytic sets is a first order phase transition as the diversity of polymers that are also candidates to catalyse the reactions they undergo, increases in diversity. Recent theorems have improved upon this initial model, simulations have shown that small collectively autocatalytic sets can emerge in this process and grow together, and also that, in the presence of inhibition of catalysis and if contained in duplicating containers, can indeed serve as plausible protocells able to evolve indefinitely.

The author has gathered some 17 scientists from around the world to collaborate and compete with one another, CERN/LHC experiments style, in a generative scientific environment.

Organised by: Ignatios Antoniadis/PH-TH & Markus Nordberg/PH-ADO.....\*\*Tea and Coffee will be serve at 16h00\*\*