Likeness Between Peculiarities of the Development of Non-equilibrium State of Bicarbonate Aqueous Systems and Developmental Patterns of Living Organisms.

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The fundamental property of aqueous bicarbonate solutions (ABS) is that they reside in a stable non-equilibrium (excited) state. Due to this they represent the simplest model of an aqueous matrix of living organisms. Their non-equilibrium state is maintained by continuous proceeding in them of Red/Ox processes with reactive oxygen species (ROS) participation accompanied with high-density energy generation. Addition of small quantities of H_2O_2 to an ABS activates these processes to such an extent that the solution becomes a long-lasting source of photon emission (PE) revealed with the help of the fluorescent probe, Luminol.

Behavior of an ABS activated with H_2O_2 is non-trivial. PE originating in ABS supplemented with Luminol immediately after H_2O_2 addition to them does not fade away as it could be expected but it rather gradually “flares up” exceeding the initial intensity tens of times. The increase in high-density energy generation indicates that the system evades from the equilibrium state. This property is characteristic for branching chain reactions with delayed branching. The only fuel that may burn in this system without consumption is water possessing reducing properties – EZ-water (G.H. Pollack) or Coherent Domains (E. del Giudice); chemical species that may provide for the delayed branching responsible for the augmentation of the non-equilibrium state of the system – are peroxides.

Another unexpected property of activated ABS is that after distribution of the solution from a common “pool” into separate test tubes individual portions of the original solution begin to demonstrate individual dynamics of PE augmentation. Immediately after filling a set of test tubes with ABS relative standard deviation (RSD) of PE intensities from these test tubes is about 5-10% of the mean, but several days later RSD reaches 50-80%. Then variability between PE from different samples decreases and RSD drops to 10-20% of the mean. The maximal variability in PE intensity from different samples coincides with the period of the maximal rate of growth of PE intensity rather than with the maximal absolute PE intensity. Thus ABS as a dynamical system demonstrates many features of “deterministic chaos”, because initially the properties of the individual components belonging to it diverge and then begin to converge approaching a certain attractor phase space. Remarkable scatter of results and discrete pattern of distribution of experimental data resemble the phenomenon of “macroscopic fluctuations” discovered by S.E. Shnoll in different physical, chemical and biochemical systems. However in our experimental system “scatter of results” is not a constant but rather a deterministically changing parameter.

Dynamics of changes in the collective properties of a discrete set of individual samples of ABS with a common genesis resembles the behavior of many developing biological systems represented by individual components of a common genesis (like multicellular organisms originated from a single cell). For example, the founder of embryology Karl von Baer discovered that during the development of chick embryos in fertilized chicken eggs at the early stages of embryogenesis individual embryos are so different in their morphology that "…it is impossible to imagine how very similar normal chickens can originate from such different embryos". He stated that in addition to acting causes (*causa efficiens*) the crucial role in biology belongs to *causa finalis* of Aristotle which was later defined by Hans Driesch and L. von Bertallanfi as equi-finality, i.e. "aspiration " of similar systems, developing along different trajectories, to come to the same state. It turns out that this phenomenon is characteristic of a "simple" dynamic water system - a bicarbonate solution, which in a sense is the prototype of living systems.