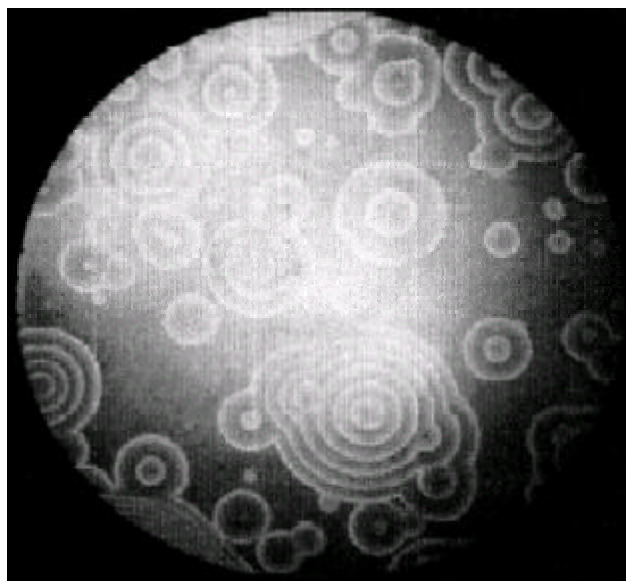
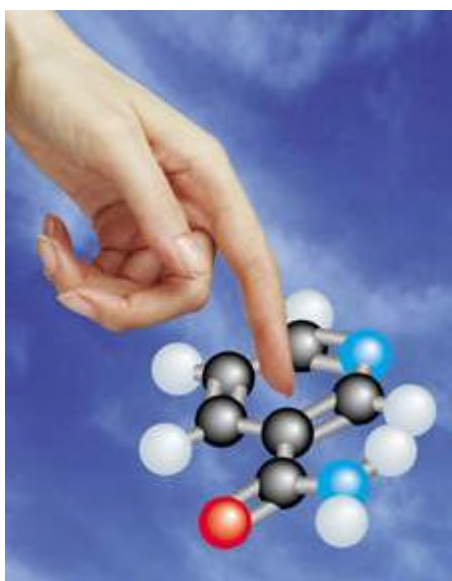




BIO-CHEMISTRY of <IN-FORMATION>:
CHEMISTRY FOR LIFE SCIENCES

Chemical bases of Biological Information.
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Preliminary - considerations.

The essential bases of biological "IN-FORMATION" (*) processing of the self-replicating bio-systems, can be researched by means the observation of the chemical self-organizing reactions. In fact DNA is not the unique informational molecule but it is only the central part of an complex networked communication of information of a catalyzed system, working within the biochemical transformation of the living cells. Hence today the flux of Bio- information is not more considered as well as an unique accident of a DNA molecular substance, but it is related to the complex changes of molecular forms in the metabolic chemical dynamic of life.

As a matter of facts any cell must be able to perform numerous chemical reactions in the right order, in space and time, and this complex approach requires a great number of specific catalysts (enzymes) as well as happen in the Krebs Cycle. This dynamic situation implies that metabolic enzyme networks including DNA molecule (named: "DNA-WORLD", i.e. biological catalyst self-assembly) , constitutes a genuine global "IN-FORMATION" processing for several cellular problem solving, that will be based on a transformational reproductive co-organization. Looking in this perspective of "DNA-WORLD" the most probable and logical explanation for biological information flow need to be revised, in a way to find a logical connection to the chemical self-organization dynamics as well as is possible to observe in the chemical transformation of the so called "Oscillating Reactions".

In conclusion "in-formation" related to the chemical and bio-chemical transformation can be seen as well as a progressive development of different evolutionary levers of catalytic self-organization of informational channels between matter and energy, so that in this way of reasoning we can understand the fundamental basis of "in-formation evolutionary planning of nature", starting from a deep analysis of chemical self-organizing systems.

(*) Footnote:

(Semantic meaning of Information is equivalent to "taking a new form" i.e. " In-Formation" ; therefore Bio-Information needs to be not confused of something having a meaning as well is included in the concept of knowledge)

BOND//NO-BOND OSCILLATING CHEMICAL DYNAMICS in transition state between high//low catalytic barriers

Starting from the above preliminary consideration the growth of living system needs to be seen as well as a complex phenomena of **"in-formation"** which lead to a high chemical collective organisation of constituted atoms and molecules. In this way, we can understand, how the life system of reproductive chemical-biology, develops by means a great deals of chemical end bio-chemical examples of collective oscillating informational behaviour.

At this proposal we start to remember that two Russian biophysicists Belousow (1951) and Zhabotinsky (1961) would like to simulate the biological KREBS CYCLE, through a more simple chemical (B-Z) reactions with a limited number of reactants, in a way that can be easy to see how chemical transformation can spontaneously organise themselves. As a matter of facts B-Z reactions demonstrate how geometric patterns, such as concentric circles, can propagate and diffuse information through an interactive interference among spiral configuration diffusing across the chemical medium and generating a complex oscillating system both in space and time.

In addition can be useful to take into account that before such B-Z experiments some spatio-temporal oscillators are experimentally well known as periodic reactions in gels, where the oscillating phenomena can be followed in a range of a slower space-time diffusion ; those oscillating precipitates are known as Liesegang Rings, because they was firstly discovered in 1896 after the German chemist Z. Q. Liesegang.

Today these two categories of oscillating reactions permits us to observe, directly by the eyes, the self organization behaviour in chemistry and hence they can be seen as an evident channels of informational diffusion obtained by the co-organization of periodical interactive structures associated with the period of transformation of any auto-catalytic system of chemical reactants.

In particular it is easy to watch, without the use of instruments, the dynamics of formation of the colourful indicators of Liesegang bands, in a way that it become unproblematic to see the coupling between diffusion of the front of the periodic precipitation 'Liesegang rings', are formed because the reactivity among reactants assumes a rhythmic performance as it can be put in evidence by coloured indicators.

The alternating sedimentation in rings of **"reaction and not reaction products"** can be understood by recognizing that the self oscillating catalysis produces an intermittent reactivity between a supercritical **NO-Bonding Region**, where the reaction between reagents do not occur, and a sub-critical **Bond –Regime**, in which the reaction between reactants can effectively take place.

A simple explanation of the space-time rhythmic alternation of **BOND//NO-BOND** precipitates in Liesegang Rings can be based on the consideration that the auto-catalyst phenomena permits to generate an oscillation of the energy barrier on the reaction coordinate (RC) during a molecular transformation between two critical states respectively in relation to high and low activation energy In a more deeper scientific approach, we can recognize that quantum dynamical processes generates a cyclic splitting of the energy barrier in a way that can separate the electron overlapping of reactants and products.

Therefore a range between higher and lower activation energy bifurcations establish the rhythmic reorganization energy barrier, in a way that it is changing the linear activity of the reaction coordinate (RC).

In fact outstanding the bifurcation of the activation energy the upper limit of the higher position of double transition state the Liesegang reaction works in the irreversible reactions throughout an negative bonding activation (NO-BOND OVERLAPPING REGION).

After quantum changes of the energy barrier, the Lieserang precipitates can work in a **"Bonding regime"**, in correspondence to a reduction of the power of the barrier; so that the molecular reactivity can shift to toward the effective bonding of end -products.

Ultimately we can also observe Liesegang Band thickness will change during the development of the reaction as a function of progressive enlargement of BOND//NO-BOND fluctuation, that probably can be associated to a tunnelling effect of the energy barrier modifying the RC catalytic path profiles. Similar influence of energy barrier fluctuations are recently detailed in the case of some elementary chemical reactions, where the effect to the reaction consists also to produce a chemical oscillation along the reaction coordinate generated by slowing down the top of the reaction barrier to the bonding region. An comparable approach was recently experimented and calculated in relation to the more simple case of the $H + HD \rightarrow D + H_2$ reaction;



http://www.nature.com/nature/journal/v419/n6904/fig_tab/nature01068_F1.html

Changing of Bond // No-Bond barriers by means catalytic effect hence represents a multidimensional cyclic -contraction of the activation energy, that alters the matrix entropy/enthalpy during the RC patting, coming from the initial chaos to a new-molecular order formation. In this manner we can establish a correlation between "In-Formation" dynamics and the control of free-energy defined by the physical structure in time and space of the Liesegang Rings realized during the diffusion of irreversible chemical oscillating process . Therefore the study of these oscillating phenomena , is very important because first it could be used as model for the comprehension of the concrete **Chemical bases of Biological In-formation flows**". As a matter of facts the Liesegang bands and more in general the spiral patterns across the chemical medium generating an oscillating reactions , can be seen as a substrate **No-Bond- channels for developing an organized patterns of "in-formation" dissemination** , so that we can interpret the spiral oscillating structures as well as chemical pathways generated for developing an effective informational planning of the self-catalyst control of free-energy during the complex relationships between chaos and new-molecular order occurring far from the thermodynamic equilibrium

Certainly the catalyst activity in biology responds to the higher complexity so that it will be co-organized with more specialized coherent planning of "in-formation". Thus passing from chemical reaction to bio-chemical self-organized promotion of metabolic transformation, we can distinguish an accurate number of specific auxiliary enzymes as well as it is needed for following the mainly accurate metabolic pathway of bio-chemical transformations as well as take place in the citric acid Krebs Cycle – where a "ring" of metabolic processes producing the specific energy transfer molecule (ATP) it is utilized for regulating the energy-transfer the cellular metabolism. Anyhow it is a pity to consider that the disciplinary division of biology from chemistry and physics till now has no taken in serious consideration the **Chemical bases of Biological In-formation**".

As a final consideration it is important to remember that Alan Turing (1912-1954) made foundational contributions to philosophy, mathematics, biology, artificial intelligence, computer science and, in this trans-disciplinary context in (1952) develops a fundamental study of no liner spatial patterns diffusion in chemistry, generated by a symmetry breaking bifurcation of energy perturbation. In this pioneering works of Chemical Morphogenesis (from *morphê* shape and *genesis* creation).

Alan Turing demonstrates by mathematical calculations how the bifurcation perturbation shows a characteristic crossover changes between two critical regimes. Therefore a "no-linear perturbation of reaction energy" produces an interval where, **the front velocity vanishes**, as a result of a interference effect the interacting wave-fronts underlying dynamical structure of **informational channels**, as well as it is previously considered in relation to the interpretation of bond//no-Bond periodic precipitates of Liesegang Rings where it can be easy to understand

how the **no-bond interactive structures** generating a free space out side of chemical reactivity can be considered as well as a concrete pathways-network of information throughout the irreversible reactions. In conclusion of this brief article on the title: BIO-CHEMISTRYof <INFORMATION>, I hope that successive studies of informational channels for long distance chemical informational communication can be developed in a interdisciplinary bio-chemical research network, focused about the studies of self-catalyzed oscillating reactions, in a way that this research can represent in the next future a key understanding of the fundamental chemical basis of biological information

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