



# Self organization of understanding, consciousness, emotions and knowledge: Cell, brain, mind, sex, life

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### Abbreviations:

**SO JOBS** – new research and clinical methods based on the SOUCEK links. Data banks and related drug testing. Mind, business, computer interfaces. Thinking machines. Long and happy life.

**SO BANG** – explosion of intelligence due to the human interventions; prosperity, but also the strange attractions and dangerous chaos (like a big bang).

**Key words:** cell, DNA code; genetic intelligence organization; cell internal language organization; consciousness; brain, mind; sex, life; SOUCEK laws; courtship; mimicry; send and receive windows; information compressing and packaging.

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## Abstract

*Background and Purpose:* This work develops the new intelligence Self Organization, SO; theory and practice.

*Materials and Methods:* The experimental data and the theoretical results come from the animal and human cell, brain, mind and sex: firefly, katydid, frog, bird, rodent, human prefrontal cortex.

*Results:* SO is a never ending, chaotic process that grows from the bottom up, without the leader or central control. It combines the inherited instructions and rules into complex processes and functions. SO laws cover the cell, brain, mind, sex, community and society. Hence they are universal. SO is composed of several basic functions, 30 laws and 100 equations. The data are measured in a short time scale from 0 to 2000 ms. The presented theoretical curves are strongly related to the experimental data.

## CONCLUSION

Internal male and female agents are the internal parents. Their internal offspring is a hybrid of their particular characteristics.

SOUCEK, new theory and practice, based on a set of SO roots, laws and functions; set of numerical equations, numbers and patterns; SO programs supported by SO agents.

SO PHYSIOLOGY, new study of the cell, brain and behaviour, based on the SO theory and practice.

SO MEDICINE, new methods that use SO, to explain and treat illness and damage to the cell, brain and behaviour.

## EXPERIMENTAL AND THEORETICAL RESULTS

This work unifies my experimental and theoretical findings. For details and equations see [www.zaklada-soucek.hr](http://www.zaklada-soucek.hr) (1–30). The work explains the life intelligence with the universal laws, SO.

**1: The roots of intelligence SO** grow from the organic mutation, variety, adaptation and evolution.

**2: The Cell Event Trains and Agents Universe** is my extension and complement to the genetic code theory. The agents intelligence is orga-

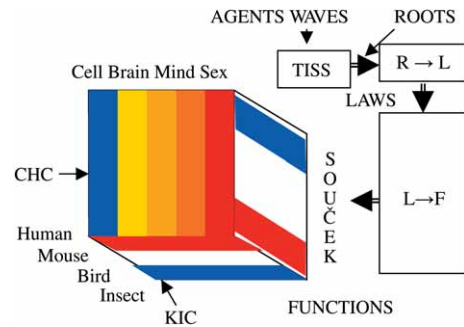
nized in the nested, fractal sequences composed of **links**. The links are compared with the mapped genes on the chromosomes of *Drosophila* fruit fly. **The Cell Internal Language Organization, CILO**, senses the neighbouring cells and the cell internal clock. CILO, new chemical signals, meters and associations constantly trigger and organize the neighbouring genes, within the link information sign set. These links grow in many different ways, **beyond the genome limits**, and do quite different things, say, in fruit fly, mouse and human. The frequency of **cell consciousness** is 5.6 cycles per 1000 nm.

**3: The living cells** grow from organic molecules according to the cell intelligence SO laws; including the Cell Event Trains CET and the cell cooperation flows. In other words, the cell grows above the chemical logic. **Cell is intelligent**. The cell internal male agents and the female agents are sending and receiving the message signs, through the windows. The messages change one or several bases at a given site on a pre-existing RNA molecule. This new RNA molecule although slightly differing from the original, would direct the synthesis of a protein molecule differing slightly but significantly from that previously produced by the cell. This explains the multiple gene to protein associations.

**4: The Brain Event Trains and Agents Universe** is a result of my long work: computerized experiments and models. To the newly discovered **agents** I have given the name of animal used in experiments: **FIREFLY; KATYDID; BIRD**. With the same agents I explain in a new way the human Prefrontal Cortex, Thalamus, Basal ganglion loops. The major brain event **trains** come from my experiments and models with the frogs and human. I show that the brain adjusts the rates of triggering and the internal time constants. In this way the brain generates various event trains: **Poisson; almost Poisson; uniform distribution; almost periodic**. **The Brain Internal Language Organization BILO** supports the agent and train links. The frequency of **brain consciousness** is 5.7 cycles per 1000 ms.

**5: The conscious brains** grow from the living cells according to the brain intelligence SO laws; including the Brain Event Trains BET and the brain cooperation flows. Many event trains are active simultaneously in the brain and mind tissue. The time intervals of trains cover a broad range from 0 to 1225 ms, with the peaks in 3,6; 25; 175 and 1225 ms. These event trains support the links between the brain agents. The links and the agents support the brain functions in the Self Organization SO of Understanding U, Consciousness C, Emotions E and Knowledge K. This is a nested, fractal, dynamic, fuzzy loop of the trains and signs. The brain signs are the pieces of mosaic used to build the mind. **The mind grows** from the brain, according to the mind intelligence SO laws, including the language, reasoning, compressing and measuring laws.

**6: The sex male/female message box** is related to the intelligence mating in: cell, CILO; brain, BILO; mind, language; sex. **Courting and mating**; mimicry and eating are present in: cell, brain, mind and sex. The male



**Figure 1.** SO BOW over the Life Intelligence; Point Associators: R→L, Roots to Laws; L→F, Laws to Functions. Red: Long. Violet: short. Point KIC, Knowledge in Insect Cell. CHC, Consciousness in Human Cell.

emits strings of bursts. The female responds after each male burst. After mating, the female converts to predatory behaviour and will no longer respond to her own male's bursts. Instead, she responds to the bursts patterns of other males, capturing and eating them.

**7: Internal male and female agents** are the internal parents. Their internal offspring is a hybrid of their particular characteristics. The trait of one parent is dominant over the trait of the other parent. The results are the **dominance, segregation and independent assortment**, which are present in four levels: cell, brain, mind and sex.

**8: The latency L** is a continuous function of stimulus and a discrete function of the context stored in the memory. In this way, the latency and answer can be switched from one window to another, although the windows are far away. **Window languages and signs** are present in : cell, CILO; brain, BILO; mind, language; and sex behaviour.

**9: The Self Organization SO** deals with the concrete pieces: the cell and brain event trains and agents. SO takes the pieces and generates the functions. SO is composed of many laws and of more than **100 equations**. SO explains in a new way the **origin of life**, as well as the animal and human **brain, behaviour and mind**.

**10.** SO opens a new science **interdiscipline**: from the smart human head, to even smarter, technical nets, computers, devices, where only the most effective intelligent agents, ideas and structures survive in a self-modifying system. The winners are used as the dominant force in the Science, Technology, BIO Medicine; Clinic; Education.

## SO BOW; FUNCTIONS; LAWS

**SO BOW**, spectrum of intelligence cycles Figure 1: from very short in cell, to very long in society (like a rainbow; from violet to red); short wave Cell; Brain; Mind; long wave SEX; **SPECIES**: short genome Insect; Bird; Mouse; long genome Human. Figure 1 indicates the common links between SO Functions of bio units and of animals. This is due to the continuous descent of bio units and of animals. SO Functions have all sorts of details in different points. Yet every Function contains the same plan. The basic pattern is the same. The single

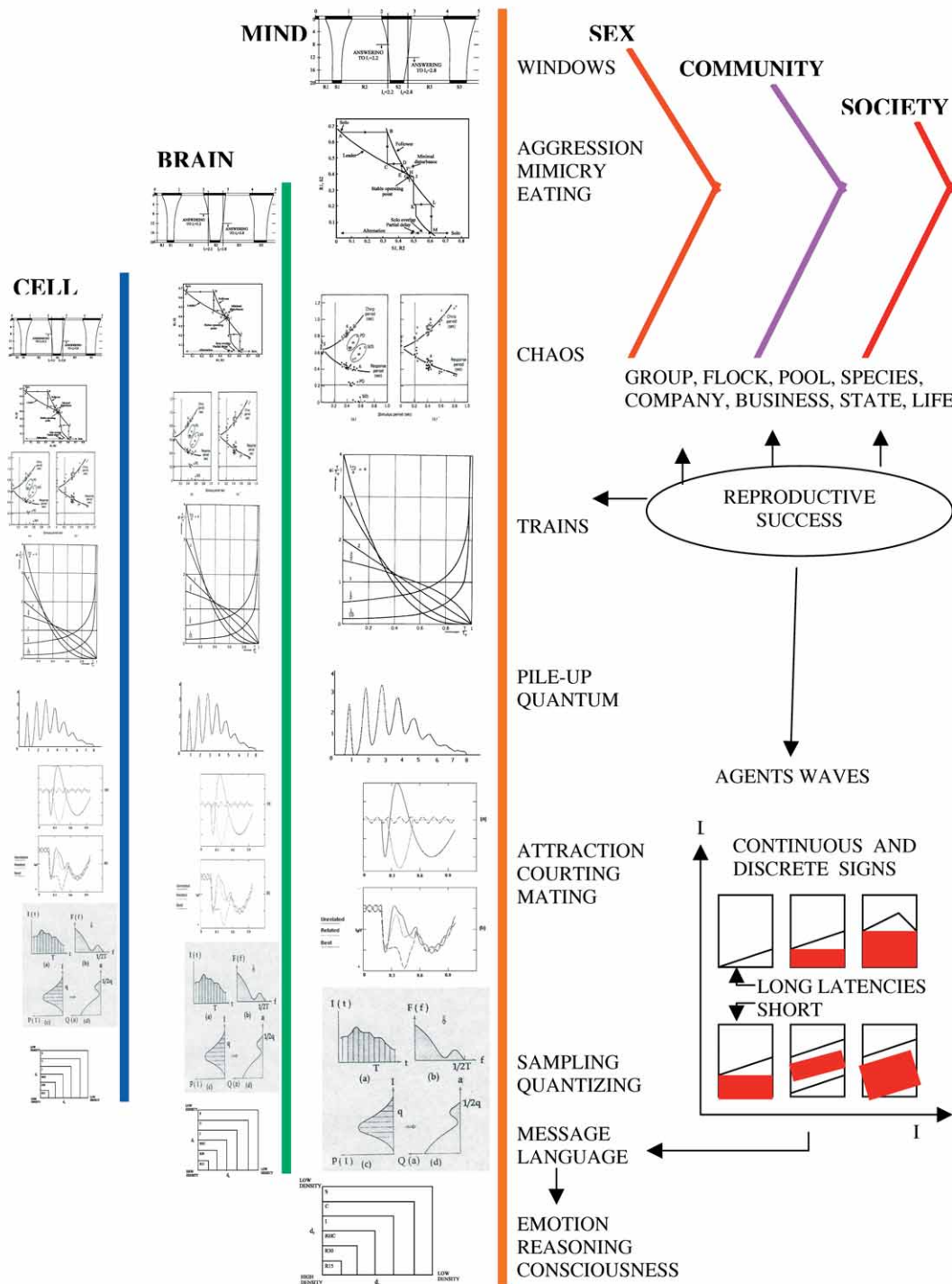


Figure 2. SOUCEK in the cell, brain, mind, sex. Origin of life.

plan testifies to common ancestry, with evolutionary divergence occurring as details become modified to fit each point to its particular way of life.

**SOUCEK**: short learned Understanding; Consciousness; Emotions; long innate Knowledge. Each of these functions is a different mixture of SO LAWS. See the Laws to Functions L > F Associator. The functions grow

from the complex associations. They are not always precisely identifiable because they overlap. The same is true for the Laws. Each law is a different mixture of the Roots, See the Roots to Laws R > L Associator.

**SO LAWS**: are common to all, but details vary between the concrete cell, brain, mind and sex; and between animals. See Figure 2.

WINDOWS Internal Language Organization

AGGRESSION in leader, follower chirps

CHAOS in agent singing, bursts; TRAINS of internal events; QUANTUM transmitter release; ATTRACTION, strong desire; SAMPLING of information; QUANTIZING of continuous signal; CONSCIOUSNESS in cell, brain, mind and sex. Other laws:

PILE – UP; CQD; BIRD agent; KATYDID agent. FIREFLY agent; neural computing; message QUANTUM; mind BARRIER; BRAMA; brain CHAOS; COMPRESSOR; REASON; METER; ASSOCIATOR; TISS; BET; brain mind SIGN; BILO; COMET; SAVA; SON; CON; LISS; CILO; GENIO; GENIUS+.

## SO SENSATION IN MOLLUSC

SO NEURAL NETWORKS define the basic behaviour of the system. Thus, models for complex animal and human behavioural features should account for electrophysiological details and complexity of the single neuron as well as the connectivity and architecture of neural networks.

Neurons form the nodes. To test the context of a neural network involved in the control of complex behaviour, the rhythmic feeding activity observed in Pleurobranchaea is presented. This carnivorous mollusc will initiate a rhythmic protraction and retraction of its proboscis when presented with food stimuli, culminating in bites and swallowing of the food. The neural elements responsible for the animal's behaviour are distributed between the cerebral and buccal ganglia. Individual elements in the model are composed of functionally equivalent neurons in the animal, and many of the connections in the network have long delays, indicating that they are polysynaptic.

1. The rhythmic behavior, once initiated, can persist even if food stimulus is taken away. 2. The feeding behavior is harder to initiate or is suppressed completely when the animal is satiated. 3. The animal exhibits choice behavior between feeding and withdrawal due to a noxious stimulus. When both types of stimuli are present, it chooses one or the other, depending on the stimulus strengths. 4. The animal exhibits the rudimentary functions of the Understanding U, Consciousness C, Emotions E and Knowledge K. These functions are present in the Self Organized loop. 5. The loop links the cerebral ganglion node and the buccal ganglion node. 6. Nodes are linked into a group.

## SO REASONING

Within the brain the evolution has created the specific sets of links: for low and high level information traffic; for short and long distances; for small and high information volumes. These are node, group, flock and pool links. In this way the architecture has a general connectivity within the group and slightly restricted between groups, flocks and pools. Very large sets of fuzzy associa-

tions may be enfolded within the same set of nodes. Stimulus-response associations are both learned and expressed in one non-iterative transformation. The neural process ideally embodies the concept of **content addressable memory**. Multiple pattern associations, at nearly arbitrary levels of complexity, may be enfolded onto a neural node. Encoded responses or »outputs« may subsequently be generated or accessed from the node via content of input. Input fields may be representative of addressing schemes or »syntax,« and are transformed in an inherently parallel manner through all of the contents enfolded within the node. In response to a stimulus signal, the node regenerates the associated output data field, indicating also the degree of confidence in that output association.

The node network is capable of enfolded associations in the sense that input of one pattern prototype will induce the issuance of the second, thus subsequently inducing the issuance of a third, and so on.

Patterns generated within a recurrent data flow may express a linear sequence of associations, each pattern association connected through its encoding within one temporal frame (i.e. associations are linked by their proximity in time). This process of linear association may be considered to be a base to the associative reasoning processes where a thought train may be expressed through a sequence of associations initially learned over time. For example, the image of a fork may invoke the impression of plate, subsequently invoking an impression response in association to a kitchen table or food, for instance. In this manner, the node, group, flock and pool systems course through a sequence of sensory impressions, each of which has been formed by associations temporally connected.

## SO HUMAN PREFRONTAL CORTEX

This region lies below the sulcus principalis, occupying the inferior frontal convexity, and comprises architectonic areas 47/12,45, and the ventralmost part of area 46 that lies below the sulcus principalis. In the human brain, the ventrolateral frontal cortical region largely occupies the inferior frontal gyrus. The Posterior region is inhabited by the Posterior flocks, pool, groups and nodes. Each of these Posterior units is involved in its **Self Organization**. All units together cooperate in the Posterior Self Organization. The posterior cortical association areas, where recently processed information is temporarily held while it is being integrated with incoming and recalled information, are connected with the ventrolateral frontal cortical region.

The functional interaction between the ventrolateral frontal region and the posterior association cortex is critical for the expression within memory of various executive processes, such as active selection, comparison, and judgment of stimuli held in short-term and long-term memory. This interaction, Cooperation and Self Organization involve two nested, fractal, brain-mind tissues: Frontal and Posterior. This type of interaction is neces-

TABLE 1

Human prefrontal cortex In mnemonic processing.

Unit	Short term patterns in FFF	Long term patterns in associators	Language areas
N	Feature	Frequent features, words	Neural networks in cortical columns
G	Chunk	Frequent chunks, phrases	Cortical columns
F	Association	Frequent, cognitive or semantic associations, stories	Temporal Lobe association area
P	Task	Frequent tasks, contexts	Anterior cingulate cortex Thalamus Basal ganglia

TABLE 2

Human prefrontal cortex in pattern recognition.

Time T	ms	Information I	SET S	Size of pattern x	Number of patterns y	Number of units z
BRA	3,6	feature	N	$10^5$	$10^5$	7·7·7
AMA=7·BRA	25	chunk	G	$10^6$	$10^4$	7·7
MA=7·AMA	125	association	F	$10^7$	$10^3$	7
BRAMA=7·MA	1225	Task	P	$10^8$	$10^2$	1

sary for active (explicit) encoding and retrieval of information, that is, processes initiated under conscious effort by the subject and guided by the subject's plans and intentions. These active forms of encoding and retrieval depend on the lateral frontal cortex. The more passive forms of encoding and retrieval result when incoming or recalled stimuli automatically trigger stored representations (e.g., on the basis of strong preexisting associations or matching to stored representations). These latter aspects of mnemonic processing do not critically depend on the lateral frontal cortex, and, this accounts for the normal performance of the brain.

**The Self Organization of the Frontal and of the Posterior regions** coordinate, interpret, and elaborate the information in consciousness to provide the hippocampal-associative-memory system with the appropriate encoding information and retrieval cues that it takes as its input. Comparable processes are involved in evaluating the hippocampal system's output and placing those retrieved memories in a proper spatiotemporal context.

**Nodes, groups, flocks and pools are »conscious«** of the various processes involved in each unit's internal memory search. They are not conscious of the operations of the hippocampal-associative system, or of the operations of the strategic frontal system that occupy consciousness. The unit is aware of the questions it delivers to other units, the answers it gets from them, and the evaluation of the answers, but it is not aware of the external operations and of the hippocampus itself. On the other hand, the complete region is involved in engram formation and reactivation in the neocortex, prim-

ing, procedural memory, manipulations of strategies, and in cognitive resources (see Table 1).

**TISS**, tissue of intelligence: Time, Information, Sign and Set. **Time T**: BRA, AMA, MA. **Information I**: feature, chunk, association. **Sign Sg**: BILO, COMET, SAVA: **Set S**: node, group, flock. These are four different, but related and precisely defined **component** classes of intelligence tissue TISS.

**HUMAN BRAIN** intelligence flow is presented in Table 2. This is an estimation of TISS optimal parameters, related to the BRAMA period of 1225 ms. In this period TISS could deal with: 1 task; 7 associations; 7·7 chunks and 7·7·7 features. In the extreme case TISS could deal with the P, F, G, N units in the same ratio: 1; 7; 7·7; 7·7·7. The N unit supports the short distance, strong flow. Large number of N units,  $z = 343$  supports the fast learning and the pattern object recognition. In other words, each N unit overlaps y patterns; of moderate size x. The situation gradually changes through G, F and P units.

Intelligence flow involves s discrete codes: words, phrases, numbers,  $s!$  combinations. They are stored in the content addressable, **specific memories s**:

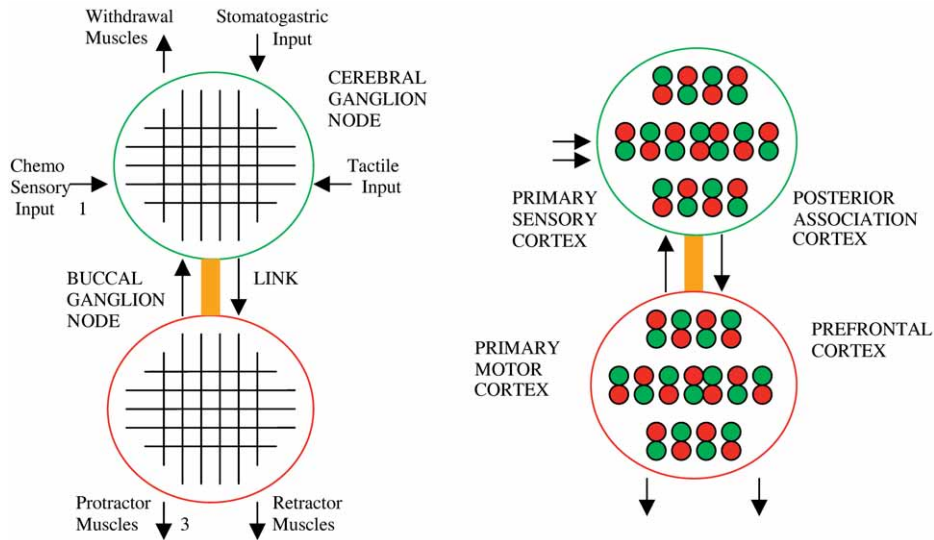
$$s = \sum \cdot z = [1+7+7 \cdot 7+7 \cdot 7 \cdot 7] = 400 \quad (1)$$

Each of s codes is associated with its xy general pattern g

$$g = x \cdot y = 10^{10} \quad (2)$$

**For the human sensory input, in a single BRAMA period of 1225 ms, the BRAIN intelligence flow INFLOW in bits is about**





**Figure 3a.** SO of intelligence in the mollusc *Pleurobranchala*. Learning and memory loop. **b.** SO of intelligence in the Brain, Mind. Many learning and memory loops.

$$\text{INFLOW} = s \cdot g = 400 \cdot 10^{10} = 4 \cdot 10^{12} \quad (3)$$

Through fractions of INFLOW, the node, group, flock and pool systems course through a sequence of sensory impressions. The brain dynamic, fuzzy and discrete combinations, flow through the internal, innate "neural and massively parallel computers" (13). As a result, only the human brain is able to construct unlimited set of discrete expressions starting from the limited set of words. This involves the SOUCEK bow, functions and laws (1 to 30).

**SO BRAIN EVENT TRAINS**

Accurate understanding of the mechanics of individual neurons and their interactions in specific brain areas has been achieved in a broad range such as: mollusk, rodents, human prefrontal cortex, frontal cortex for mnemonic processing, neural computing. The goal is to reveal how brain operates. In this work and in (1 to 30) I present an entirely new explanation, SO of intelligence. Animal life grows above the chemical logic. The life involves also the SO of intelligence. SO is composed of many oscillators and of the massively parallel random event trains.

Figure 3 A presents the SO in the mollusc *Pleurobranchala*: The Cerebral Ganglion Node and the Buccal Ganglion Node. The neural networks are presented as single neurons. The two nodes are linked into a group. Here are rhythmic feeding behaviors of neurons produced when food stimulus is presented to neuron 1:

```

LLLLLLLLLLLLLLLLLLLLLLLLL      1
LLLLLLLL LLLLLL LLLL           3
    
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The protractor and retractor neurons fire in alternating trends of action potentials, and the feeding activity, once initiated, persists even when food stimulus is

removed. The node response combines the train of action potentials with the bursting and oscillations. The synaptic efficiency is influenced by the width of pre-synaptic action potential, postsynaptic time constant, learning and memory. When the Cerebral ganglion senses the environment, it creates the transcriptor BET. BET switches the Buccal ganglion, that creates BET'. Through the link, BET, BET' form the learning loop. The loop is active even after the stimulation. This is a memory of the past environmental condition.

Figure 3 B presents the brain-mind activity composed of processes. A process starts, performs actions and finishes. Many processes are active at the same time, and processes can send messages to one another. Several communicating processes could run on several nodes, or concurrently on the same node. The same is true for groups, flocks and pools.

Many laboratories through years have collected thousands of experimental data files. Yet it was difficult to explain the neural processes. Now, the random neural processes are explained by equation 4:

$$g(x) = \lambda \tau_2 (1 - x) / a = \lambda \tau_2 (1 - T/T_0) / a \quad (4)$$

The life is a set of chemical and of intelligence processes, and of equilibrium. Equations in (1 to 30) explain the cell and brain intelligence processes. Known organisms share a similar bio SO, and an almost identical set of SO processes, laws and functions. See Figures 1, 2 and 3.

$$\text{Life} = \text{DNA logic and SO intelligence} \quad (5)$$

A link unit connects the process on a point to point basis. It operates with the continuous and discrete information (CQD), as well as with the information trains. Hence the link behaves as 1) neural network; 2) holographic network; 3) discrete, fuzzy processors with local memory. This is very different from computer chan-

nels which only carry discrete data and messages. Links are polite, aggressive or patient. The polite link will wait until the process is supplied. Equally, an output will not be sent until the receiver is ready. The aggressive link will interrupt the process. Each TISS unit has its Local Primary Oscillators, Timers and BRAMA-like Protocols. TISS Self-Organization includes: **1)** Synchronization; **2)** Merging towards the set of attractors in parallel chaotic activities; **3)** Temporary reconfiguration of the topology. TISS runs through a lot of temporary topologies; **4)** Slight local changes in the case of inherited, instinct, born with actions; **5)** Some local changes in the case of learning, adaptation and conditional reflexes; **6)** Distance temporary changes in the case of creative thinking and of mind wandering. The brain-mind tissue is composed of many TISS that form the dynamic never repeating active sets. These active sets operate in parallel, sequential or overlapping modes. TISS is composed of the dynamic, fuzzy, nested, fractal clouds. Many associations can be **distributed** one over another in the same cloud. Hence they **overlap**. This is combined with the **partial selection**. Dynamic, nested, fractal **TISS cancels the border between the brain and the mind. There is only one brain-mind tissue, TISS.** TISS generates fuzzy overlapped functions, such as Understanding, Consciousness, Emotions and Knowledge. Instinct inherited knowledge or predisposition is located in fixed areas. Learning from the environment and reflexes are dispersed around these fixed areas. Creative thinking, thought wondering, imagination come from the active areas all around the brain-mind structure. Each unit and agent has: The response function responsible for the inherent built in program; transfer function which deals with the input-output relations; continuous and discrete long term and short term working memories. Hence the unit and agent have the representation of the local world and to some extent are free from the environmental dependency. The units and agents communicate using the Brain Internal Language Organization BILO. The firefly **understands, U**, the courting message through the receive windows. The mollusk is **conscious, C**, of the presence of the food and enters into a rhythmic feeding behavior. The firefly after mating changes her **emotions, E**. She is not interested anymore for a courting partner. She is now inviting a visitor that she could eat. The bird inherits the **knowledge, K**. This includes the song that the young bird inherits from the parents, and then improves through learning. Katydid **associates, A**, the chirping call with the potential courting partner and with its location on the tree. In short, each animal as well as each TISS unit and its agent performs the local Self Organization of the local U, C, E, K and A. All units and agents together Cooperate in the overall TISS Self Organization. TISS involves the context switching as observed in fireflies; chaotic attractions as observed in katydid; continuous and discrete messages as observed in birds. The FFF information transmission and mixture combines the neural impulse trains, with the fast acting transmitters: inhibitory GABA; excitatory glutamate; and modulatory dopamine, serotonin and acetylcholine.

## CONCLUSION

**GENETIC and BIOLOGY theories:** Animal cells grow and operate following the fixed, genetic, DNA, **logic** and programmes (or mutations). Animal and human innate, instinct behaviour follow the fixed programmes. Cells and animals are not supported by languages.

**SOUCEK theory.** The fixed genetic and instinct logic and programmes are supported by the parallel internal languages, CILO, BILO: with the continuous signs and with the discrete codes; with the fuzzy, adaptive coded windows. These are internal simple words and phrases; and the context switching. In this way animal cells, as well as the animals, are able to learn and understand. The same is true for the animal and human brain mind internal units: nodes, groups, flocks and pools. Cells, units and animals are intelligent, within their specific domains. **Hence the animal life grows above the chemical logic. The life is intelligence. The origin of life and consciousness is in the genetic intelligence universe GENIUS+, developed by chance. This involves the SOUCEK bow, functions, laws and processes (1 to 30).**

**DNA logic involves the slow adaptation** and pre-adaptation by chance. SO intelligence combines in a new way the already available preadaptation. In this way **SO intelligence creates the fast evolution.** This is a »cultural« development within the cell and brain, based on the internal SO processes and languages CILO, BILO (1 to 30).

SO processes are active in the cells and neurons. They explain the learning (growth of synapses) as well as the memory (new synapses), see (1 to 4). SO processes in the inter spaces and extra spaces extend the Genome to Proteome growth and the sensing of environment (29, 30).

**AGENT** is a blob of matter similar to the school of fish, flock of birds or colony of ants. See Figure 1. The agent's behaviour is built from the bottom up, involving the primary oscillator. **Primary oscillator** generates the special, link sequence. In other words, the communication features of the agent are controlled by an oscillator which defines the behaviour. Hence, it can be called the primary oscillator. The primary waveform produces the sequences in cooperations with the window and answer waves. Hence, an agent is a set of oscillators; a set of waves. Agents are attracted by the internal chunky patterns: modest attraction, unconsciousness and intuition; strong attraction, consciousness and understanding.

SO explains the patterns of neuronal organization and the way they work. SO is the advanced stage of the attempt to understand the brain, which may well be the last of all the frontiers of knowledge that man can attempt to penetrate and encompass. The brain research will occupy the years of our future. Vigorous and exciting new disciplines emerge: neurochemistry, molecular neurobiology, neurogenetics, neurofarmacology. But also: **brain communications, brain networks, brain computers and brain theories.**

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