

# Dialoguing – Delusion or Physical Reality?

Revisiting Cybernetics as “*the Science of Communication and Control in the Animal and the Machine*” (after N. Wiener’s)

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## Abstract

Both theoretical and recent experimental results show that evolutionary systems are necessarily endowed with anticipatory and holistic properties. As a consequence, the act of dialoguing analyzed through entropy exchanges and interference of noise is doomed to be somewhat delusive. The loophole out of microanatomy complementarity as the actual incommunicable unsplitable, holistic self can be an energy-free, i.e. purely non commutative geometric, approach to its hierarchical dynamics or in a co-evolutionary process involving the dialoguing partners..

**Keywords:** evolutionary systems; self-organization; anticipation; nanochaos; coherence

*“Information is deeper than reality”*

Anton Zeilinger <sup>1</sup>

*“You are not thinking! You are merely being logical!”*

Niels Bohr to Albert Einstein <sup>2</sup>

## 1. Introduction

Dialoguing as an exchange of ideas and opinions is a capacity taken for granted concerning mankind, and for Greek philosophers, in particular Plato and Aristoteles, “*dianoia*” was the term designating discursive knowledge, which proceeds step by step, as opposed to intuitive knowledge or “*noesis*”. So *dianoia* as the *capacity for, process of, or result of* discursive thinking was taken to identify the intellectual virtues concerning reason as a principle of knowledge of facts and of evaluation of situations and guidance of behaviour (art, science, wisdom, knowledge, thinking) as opposed to ethical virtues, concerning the problem of human action. The result of dialoguing is communication, or the interchange of thoughts or opinions by a process by which **meanings** are exchanged between individuals through a **common** system of symbols, i.e. language,

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<sup>1</sup> Said by the physicist Anton Zeilinger to M. Buchanan in New Scientist, No. 2125, 26 – 30 (1998).

<sup>2</sup> Said by Niels Bohr to Albert Einstein during one of their heated discussions in which Albert Einstein was challenging Bohr’s unorthodox physical views, cf. K.C. Cole, *Sympathetic Vibrations: Reflections on Physics as a Way of Life*, Bantam, New York, 1985, pg. 204.

signs or gestures. And communication can be used to control **somebody** or **something**, i.e the “**environment**”, to exercise a restraining or directing influence over the same. Are there any limits to this capacity for dialoguing – **with communication and/or control as outcomes** – and if so, what are they?

The philosophical terms *dianoia* and *noesis*, and the commonsense interpretation of the term *communication* can now be approached from a scientific standpoint on the basis of recent achievements in nanoscale physics of biosystems, this analysis being particularly important for deepening the concepts of biological self-organization and evolution, and for a physical understanding of the perspective biomimetic nanotechnologies which, in addition to try and make biosystem *metaphorical* artefacts into actual biosystem models, aim at the envisageable powerful integration *on the nanoscale* of biological and artificial systems. Cybernetics as “*the Science of Communication and Control in the Animal and the Machine (after N. Wiener’s)*” is to be revisited in the light of very recently experimentally validated or theoretical concepts in *nano-to-micro dialoguing* possibilities involving biosystem-to-bioartefact integration into *sensing – information processing – actuating* systems [1, 2, 3]. Indeed, dialogues through a given *syntax, semantics* and *pragmatics* as spatially and/or frequency coded interactions occur among the nanoscale subcellular members of biosystems just as in human and animal macrolevel communication [4, 5]. Any self-organizing and evolutionary artefact, as a far-from-equilibrium and thermodynamically open system [4, 6, 7], would feature such dialoguing capabilities throughout its whole informational, dissipative dynamic hierarchy as intra-level and interlevel communication, and ultimately with its environment, the nanoscale level dynamics being possibly an expression of an underlying microphysical dynamics [8]. And human language itself – the tool for our dialogues that originates in the microphysical and the hydrodynamic/thermodynamic physical level of a nanoscale-integrated and plastically interconnected cellular network [9, 10] – has been described as a self-organizing system [11]. Accordingly, what would logic, semantics and pragmatics mean physically in the micro/nanoscale dynamics of dialogues between self-organizing cognitive evolutionary systems?

## 2. Framing the Problem within the Realm of Nanoscale Physics

The following analysis, being based on a nanoscale physical approach, will contemplate both the hydrodynamic/thermodynamic level classical dynamics and its underlying quantum physics.

The physics and thermodynamics of evolutionary systems [12] shows that the necessary condition for a self-organizing, open and far-from-thermodynamic/mechanical equilibrium system to be evolutionary is *cognition* or *elementary self-awareness*, which is to be taken here to mean that each *hardware–software* (dubbed here *evolware*) unit of the system is capable to describe itself and to reproduce itself, as well as to decode (to dialogue with) the underlying unit in a hierarchical informational dynamical chain. The well known conception in Biology of living beings as systems made up of units featuring solidary unity of structure and function becomes in this perspective the

indistinguishability of structure (the energy of dynamic ongoing) from function or the *symbolic* description. On the nanoscale, this solidarity means the close connection between electronic (quantum orbitals) and mechanical (nuclei dynamics) degrees of freedom. As argued in the following, physically this implies a semantic component in information processing, that together with what is called syntactic (logical) and pragmatic information makes up the so-called "*biological information*" which ultimately is inseparable from the living subject itself, be it the most elementary biota or a highly evolved being, to which that complete information makes sense.

Stated otherwise, the "*meaning*" of a message in a dialogue, e.g. of a genetic message, is only discernible in the *concrete evolutionary process*: cells, and even any simplest biota, not only process information as a message consisting of syntax, semantics and pragmatics, but *they also are their own interpreters*, e.g. for simulating their environment, and the recognizers of that information [4, 13]. *Simulation* is here the dialogue with the environment, to decode its signals for survival and development; according to our present views, such environmental and intra-/inter-level dynamics simulation would occur through nanoscale chaotic dynamics and/or analysis and synthesis through the non-commutative nilpotent Heisenberg Lie group of symmetries of the convolution structure of the wavelets originating from a mother wave in the case of phase coherence under the action of a Fourier transform [3, 5, 12]. As to the notions of code and information, it is to be recalled here that both terms were shown to have nothing to do with the same terms as used in telecommunication or (syntactic) computer science [13]. Contrary to the (unphysical) principle of Artificial Intelligence, mimicking Biological Intelligence means mimicking codes originating physically from a semantic processing of time series from the environment which impinge on the evolutionary being and are convoluted with their inside dynamics.

The "*tuning view*" [14, 15] according to which an organism has to "*compute*" just its own environment, with which it shares, through its own origin and evolution, some relevant states, can be put in more physical terms saying that this kind of "*resonant coupling*" (tuning) through nanochaos and/or through the non-commutative nilpotent Heisenberg Lie group of symmetries of the convolution of the environmental time series originates through the highly nonlinear [8] *active* and, as was experimentally validated, *anticipatory* role [16] of subcellular network members. The biochemical and genetic experimental results [16] leading to the concept of "*molecular strategies*" can be described as stemming from a physics of the intracellular medium, mainly the cytoplasm, as a nonlinear self-organizing active environment providing *positive* molecular friction, e.g. first by storing a part of its energy input as potential energy (*conformational modes* of complex macromolecules and supramolecular structures) or as kinetic energy (*lattice oscillations*), and then releasing it as nanoscale-level *active* friction to an "*activated (system + reservoir) transition state*". Moreover, interacting Heisenberg's electron and photon fields should be added to Heisenberg's molecular field to describe the microphysics of self-organized charge transfer processes, of primary importance in biological processes, embodying coded interactions from unitary and non-unitary events which show in the macroscopic level processes of the living being because they strongly lower the activation entropy and then the activation energy of such processes.

### 3. Dialoguing as the Breaking of Physical Codes

Accordingly, dialogues between an evolutionary system and its environment, the latter including another similar or different evolutionary system (even an alien being?) present problems. Indeed:

- 1) they include *noesis* by and large, physically identifiable through Liouville's theorem as will be discussed in the following, in addition to *dianoia* as the logic discourse. In any *evolware*, an energetic dynamics at the hardware level (*structure*) is described symbolically on the informational level (*function*): this raises problems of logic and metalogic, which forbid self-reproduction in von Neumann "*self-reproducing automata*" [17] as physically real self-reproduction. In such merely syntactic machines, the problem is solved by introducing the reproduction program from the outside: it is the designer who actually causes reproduction, and the whole machine is just a logical extension of his/her own thinking capabilities. Here the self-referential situation actually leads to a paradox. How is this problem solved in really self-reproducing, *autopoietic* biosystems?
- 2) as observed above, evolutionary systems, while dialoguing, process information as messages consisting of syntax, semantics and pragmatics, and *they are their own interpreters*, e.g. for simulating their environment, and the recognizers of that information. Thus the semantic character of biological information introduces the possibility of a **barrier of meaning** in the exchange of messages, that from the nanoscale can reach up to the macro-world and vice-versa. Messages may become mere signals, bearing no meaning at all. For intelligent alien beings, who in our imagination usually have a science and a technology much powerful than ours, Dante's "*Comedy*" might be as dull as a telephone directory to us.
- 3) *Uroboros*, the dragon that bites its own tail as the ancient symbol of self-reference, creeps in the evolutionary hierarchy of levels of *increasing abstraction* (i.e., on the nanoscale, of *smaller numbers of degrees of freedom*), while such dialogues are going on, as far as abstract rigid logic is supposed to have the dominant sway. How can logic levels coexist with semantic processes in which information exchanged by dialoguing is not merely copied through a one-to-one mapping like in a Xerox machine, but compressed into *collective properties* as the *abstractions* mentioned above, that can be described as featuring smaller numbers of degrees of freedom? Actually, any *learning* process in the biological system doesn't come from pre-programmed instructions from the outside, but is a real self-organization process that on the logical levels would lead to Gödelian undecidability paradoxes. How can the dynamics of dialoguing escape such paradoxes?
- 4) biological intelligence as the capability of processing information as discussed above, and the concept of biological information as a built-in property of the solidary structure-function unity seem to shape the evolutionary system into the

form of a Leibnitzian monad as an impenetrable unit of perceptual reality; are there loops out of this view?

- 5) as will be shown in the following, evolutionary systems trying to break a code in a dialogue can meet with entropy exchange problems
- 6) nanochaos is largely used for describing brain dynamics; but as will be shown, signals that can be actually processed by the evolutionary system through that dynamics in a dialogue with the environment are a very small fraction of the total signals from the environment: most of them keep fully undetected. While full detection would probably mean for the system to be informationally overwhelmed by the environment itself through entropy exchange blockage (cf. 5) above), the small number detected sets forth a limitation to the number of categories *physically realizable* in the system itself.

The apparently trivial possibility of dialoguing actually shows to be a matter of reciprocal breaking the codes of the participants, a task that looks like being at least partially invalidated by a number of problems that boil down to the question: is dialoguing a delusion, or a physical reality?

#### **4. What are *Delusion* and *Physical Reality*?**

The physics of dialoguing between evolutionary systems – the reciprocal breaking of their own codes – is quite subtle; delusions in the sense discussed in 4.1 may creep in during such exchanges of information. Paradoxical self-referential situations may invalidate some results of dialoguing; their analysis shows them to be unphysical, i.e. to be just delusions.

##### **4.1. Delusion: a Matter of Lexicography**

*Delusion* according to Webster's is a false belief or a persistent error of perception, or a customary or fixed misconception, unconquerable by reason in something that has no existence in fact. For instance, the passage of time is, in the Einsteinian view, "*a delusion, persistent though it may be*".

##### **4.2. Physical Reality: from Einsteinian *Completeness* to Non-paradoxical Self-reference in Self-organizing Cognitive Systems**

According to the famous Einstein-Podolski-Rosen paper [18] about the validity of the quantum-mechanical description of reality, it is stressed that a distinction is to be made between objective reality, which is independent of any theory, and the physical concepts with which the theory operates. These concepts are intended to correspond with the objective reality, and by means of these concepts we picture this reality to ourselves. Let us see how the notion of objective reality is felt in the Einsteinian *well established* physics of energy and how it is felt in the *prospective* physics of information, the latter being a real must for an understanding of life and biological intelligence.

#### 4.2.1. Physical Reality as Completeness

In [18] objective reality is identified with the correctness of a theory, judged by the degree of agreement between the conclusions of a theory and human experience, i.e. of theory with *experiment* and *measurement* (the Galilean concept that established modern science) and with *completeness* of description by the theory itself. The completeness condition consists in the fact that every element of the physical reality must have a counterpart in the physical theory.

#### 4.2.2. Physical Reality as a Tautology

A physical understanding of evolutionary systems as necessarily open, far-from-equilibrium, self-organizing and cognitive systems asks for a better understanding of the physical meaning of information, which has been shown [4, 13] to be conceived for such thermodynamic and quantum-mechanical based systems as a fully different notion from Shannonian information. This emerging concept of physical information shows that, in addition to the Einsteinian notion for the physics of energy, it is necessary in a sound physical theory of evolutionary systems to beware of *Uroboros*, i.e. of paradoxical self-reference.

*Uroboros* is on stage in any dialogue, but not necessarily with an invalidating action. Its presence can be observed in non-paradoxical self-referential relationships. For instance, the Einsteinian principle for Galilean science tells us ultimately that a scientific law is just a non-paradoxical tautology, whose power consists in telling that if all things are not otherwise, they are so and so. All definitions are conventional. The ability of the scientist who chooses a felicitous, i.e. *fruitful*, definition consists in selecting (intuitively, no logical thinking is at work at that point) those correspondences that can generate other concepts acting as keys for translating theoretical symbols into enunciation of facts. Accordingly with such our principles, *truth is just fruitfulness*. Setting forth that the freezing point of water is 0°C and its boiling point is 100°C tells nothing, but the concept of degree of temperature is derived from such definitions of correspondence and through a long chain of facts and scientific laws – compressions of messages into smaller degrees of freedom – a whole set of theories has been built, e.g. the Big-Bang theory.

The consideration of the presence of *Uroboros* can also be illuminating in some basic questions. For instance, its non-paradoxical presence in the case of our dialogues with the environment, when we are looking for fundamental laws of the Universe, is actually devastating as to the notion of chance. Indeed, such laws are compressions into increasingly abstractions of data from sensing and actuating, their compression going down to elementary agencies as electrons, elementary particles, quantum fields. This whole simulation process makes the lowest level of the dynamic hierarchy to merge with the highest abstraction level in the form of a wide scope tautology. As a consequence, should we be thought of as *fully unforeseeable* products of the laws of the Universe, i.e. products of mere chance, how is it that our evolware can *simulate* just the

fundamental laws of the Universe that, acting upon matter, have generated its formation?

Really paradoxical self-reference is met in applying abstract logic to evolutionary problems [4]. It is semantic information that, while generating the barrier of meaning, dispels Gödelian paradoxes and Turing halting problem [4, 12, 13] and allows the “*cybernetic crisis*” from non-polynomial time computability problems in evolution [4, 13] to be overcome. Paradoxical infinite self-reference regressions are dispelled. Thus the merging of the lowest with the highest abstraction levels into “knowledge” as tautologies is a non-paradoxical self-referential relationship: it is the entropic, i.e. non-conservative *protein folding* in biological self-reproduction that escapes the logic – metalogic paradoxes in von Neumann’s so-called self-reproducing automata. Abstract logic, physically identifiable as integrable Hamiltonian dynamics, might co-exist, e.g. as an effect of different relaxation times and consequent parametric isolation of some zones in a system [4, 12], with the basic dissipative dynamics that generates semantics and evolution, but it absolutely could not be a source of evolution. In the case of the “*language*” levels engaged in the dialogue, there would be no learning and, as shown in Section 5, it might lead to the full degradation of the organized evolutionary system. It is a dissipative process, for which the dot product of the vector nabla operator and the vector form of the flow  $\mathbf{f}$  (trajectory or map) of information in state space is negative

$$\nabla \bullet \mathbf{f} < 0$$

that makes the volume in state space not invariant, i.e. it is compressed, i.e. *shrunked* so generating *new* information (i.e. not contained in initial and/or boundary conditions) and any *logico-deductive premises*: noesis vs. dianoia. Stated otherwise, any time series impinging on a nanobiological level where Hamiltonian dynamics is dominant would keep its number of degrees of freedom unchanged (no compression into an abstraction). The external stimulus would be merely copied. But, as will be discussed in Section 8, Liouville’s theorem of statistical mechanics

$$\nabla \bullet \mathbf{f} = 0$$

for Hamiltonian *syntactic*, i.e. merely logical, dynamics sets forth a cosmological problem concerning our dialogues with the Universe and the ultimate meaning of self-organization, evolution, learning. Again, delusions or physical realities?

## **5. Across the *Barrier of Meaning*, down to a Principle of *Microanatomy Complementarity*?**

Let us consider the dialogue between two evolutionary systems, i.e. the “*breaking of codes*” mentioned above, and let us call in a very general way “*words*”, “*syntax*”, “*semantics*” and “*pragmatics*” their means (their “*language*”) for producing signals embodying some meaning. As language and cognition determine the pattern both of the structure and behaviour of the evolutionary self-reproducing being in its environment, in addition to symbolics also pragmatics, which is linked to effector organs, is to be

involved. The concept of a fully abstract “*intelligent system*” not endowed with sensors and actuators cannot refer to evolutionary beings. Within what has been dubbed here “*evolware*”, what are the details of the interfaces between energetic and symbolic interactions? At our present state of knowledge we cannot answer the question about how word formation (again as a general term), inflexional and syntactical rule and semantic associations as symbolic activities are related to the chemical and physicochemical interactions, possibly involving quantum mechanics, of the hardware. However, at the thermodynamic level the dialogue can be modelled as follows, with some interesting conclusions.

Let the two systems be non interacting in an environment that can act as an entropy sink, and let  $[dS_i(t)]_M$ ,  $[dS_e(t)]_M$ ,  $[dS(t)]_M$  be respectively the entropy produced by the irreversible processes within the energy/information processing levels of the partner **M**, the entropy associated to the matter/energy flow between **M** and its environment, and the total entropy change of **M**; let  $[dS_i(t)]_N$ ,  $[dS_e(t)]_N$ ,  $[dS(t)]_N$  represent the same quantities relating to the partner **N**. So their entropy balances will be

$$[dS(t)]_M = [dS_i(t)]_M + [dS_e(t)]_M \quad (1)$$

$$[dS(t)]_N = [dS_i(t)]_N + [dS_e(t)]_N \quad (2)$$

At steady state for **M** and **N** coupled to their common environment but not trying to communicate we have

$$[dS(t)]_M = 0 \quad \text{and} \quad [dS(t)]_N = 0$$

$$[dS_e(t)]_M = - [dS_i(t)]_M < 0; \quad [dS_e(t)]_N = - [dS_i(t)]_N < 0$$

which means that both dissipative systems inject entropy into their environment and so keep far from thermodynamic equilibrium, i.e. *from death*: they feed on negative entropy. Now let **N** send strings of symbols of its language to **M** for its interpretation (compression). Equation (1) can be applied to the thermodynamics of the linguistic levels in **M** engaged in compression. It will always be

$$[dS_i(t)]_M > 0$$

But what about the sign of  $[dS_e(t)]_M$ ? It depends on the correlation capabilities of those levels. Many strings of aperiodic sets of symbols *received* by **M** and kept uncompressed means injection of much entropy, i.e. a positive value of  $[dS_e(t)]_M$ , so that  $[dS(t)]_M$  will increase in time within those levels. Critical intralevel conditions may arise throughout the whole hierarchical dynamics, till complete deterioration of all organization of **M** (*thermodynamics is valid whatever that dynamics is*) unless the language levels of **M** can incorporate a mechanism that makes possible the increase of maximum entropy  $[S(t)]_{Mmax}$  of **M** at a rate faster than  $[S(t)]_M$  so that redundancy *R* at such levels

$$R = 1 - [S(t)]_M / [S(t)]_{Mmax}$$



can increase in time even though  $[S(t)]_M$  increases, so keeping the condition for evolutionary behaviour. Otherwise, intralevel distinctions in  $\mathbf{M}$  would be lost in time with destruction of the organized hierarchical dynamics. This shows that the language levels made up of a fixed number of active elements must incorporate as a constitutional prosthesis a set of levels of increasing number of active components to resist the code-breaking effort.

If  $[dS_e(t)]_M < 0$  and  $|[dS_e(t)]_M| < [dS_i(t)]_M$  this means that the levels of  $\mathbf{M}$  involved in the dialogue can compress a part of the incoming strings of aperiodic symbols from  $\mathbf{N}$ , with consequent slower increase of total entropy  $[dS(t)]_M$  and slower degradation in time. The intralevel dynamics and the coupling with the environment would be determinant for the time behaviour of this dialogue. Should the environment not be an entropy sink, or the language levels be incapable of keeping  $R$  increasing in time, any "friendly" dialogue might become a deadly game for both partners or for one of them.

A limitation to information actually processable in the dialogue, independently of the kind of processor, be it of nanochaotic or adaptive resonance tuning through Heisenberg Lie group organizing computing, is given by the percentage of the total number of time series which are compressible to  $K$  bits. Estimating this percentage is a problem in algorithmic complexity in Chaitin's sense, independently of the dynamics that generates complexity in the dialogue. The time series consists of symbols among which no intrinsic interconnection exists. The total number of such unforeseeable series of length  $N$  that can be got is  $2^N$ . The percentage  $\varepsilon$  of such series, each one being a priori expectable by one of the dialoguin partners with equal probability  $2^{-N}$ , that can be compressed to  $K$  bits, or stated otherwise, the number of series that can give rise to an algorithm of length  $N - K$  which, if fed into a finite state machine, yields an output consisting of the full series of length  $N$ , is obtainable as follows.

Let, without loss of generality, the time series consist of symbols 0 and 1. "Words" of length  $n$  bits are  $2^n$  in number. Accordingly, we have

*total number of series compressed up to  $K$  bits =*

$$2^1 + 2^2 + 2^3 + 2^4 + \dots + 2^{N-K-1} = 2^{N-K} - 2^1$$

and

$$\varepsilon = (2^{N-K} - 2^1) / 2^N, \quad \varepsilon \approx 2^{-K} \text{ for } N \gg 1$$

Thus  $\varepsilon$  decreases very rapidly with  $K$ ; for  $K = 10$ , just one series in a thousand is compressed to 10 bits. In spite of the presence of even a numerous set of compressing members, e.g. nanochaotic attractors, at each cognitive level for dialoguing, the percentage of those which really are operating is just  $2^{-K}$ , a very small number, i.e.

the dialoguing system can simulate a very small number of the signals coming from its partner. In case the partner is Nature, this means that we can simulate a very small subset of natural phenomena, a large majority passing through our brain fully undetected. And here again a question equal to that in 4.2.2 can be set concerning *chance*. Indeed, small though  $\varepsilon$  may be, the compressors actually have as their basins the set of externally impinging time series. This would mean that a kind of homology exists between some patterns of the external world and the categories of our evolware (the brain as a structure – function solidarity). But in this case we can again ask, as in 4.2.2: should we be thought of as *fully unforeseeable* products of the laws of the Universe, i.e. products of mere chance, how is it that our evolware can *simulate* just the fundamental laws of the Universe that, acting upon matter, have generated its formation?

Another strong limitation in trying to cross the barrier of meaning consists in the structure – function solidarity of evolutionary systems. What if even the simplest biota are their own interpreters of the information they are processing in simulating the environment or the other partner in a dialogue, and if the “*meaning*” of a message in a dialogue, e.g. of a genetic message, is only discernible in the *concrete learning as a self-organization and in the concrete evolutionary process*? This would support the hypothesis of a *microanatomy complementarity*, in the sense that thought processes, or more generally self-organization processes, change the microanatomy of the brain or any other language level evolware, due to capabilities of memorizing and of dialoguing while keeping  $R$  increasing with time (which means the addition in time of degrees of freedom to the organizing level, e.g. by means of *flexible* macromolecular chains vs. the rigid members of computers and supercomputers and through the continuous metabolism) so that observation of the function of the language levels of any evolutionary cognitive system inevitably changes the anatomy of that evolware, so suggesting an unavoidable complementary description of the *structure – function* dichotomy. A loophole out of that hardly contestable Leibnitzian view of evolutionary systems as monads – the *actual incommunicable unsplitable self* – may be found.

## 6. Noncommutative Geometry, Platonic Noesis and the Semantic Barrier

The physics of information as developed above of an evolutionary system as an autopoietic machine, i.e. a machine organized as a network of transformation and destruction of components that continuously regenerate and realize the network, by increasing in time the number of their degrees of freedom to avoid degradation from entropy production in energy and information exchanges with their environment thus sets forth such a machine as a concrete unity in state space in which the components exist by specifying the topological domain of its realization as such a network; the space so defined in which

$$\nabla \bullet \mathbf{f} < 0 \quad (3)$$

is self-contained and cannot be described by dimensions defining other spaces, so that our descriptions of that space actually are projections of that system on the space of our experimentation, which is our own semantic space. Stated otherwise, semantic spaces, contrarily to syntactic (logic) spaces, are unattainable in their ultimate essence. The unattainable root of the “I”? Can dialoguing solve the problem of a scientific description of an autopoietic hierarchical evolutionary system, i.e. of its structure-function solidary unity?

The answer to the second question is yes, at least in principle, if in the *breaking of codes* not just energetic investigations implying computability are carried out, but also a geometrical strategy is followed in trying to set forth cause – effect relationships between levels of different energetic dynamics and yet linked by symbolic dynamics in the evolutionary hierarchy. Leaving energetic interactions and computational strategies out, the possibility can be investigated of correlating the geometry stemming from interactions in each dynamic level. The so-called *geometric quantization strategy* [19] based on noncommutative geometry and Lie groups through Heisenberg’s commutation relation has been shown to be a powerful technique to investigate structure – function relationships.

On the basis of inequality (3), *co-evolution* of the dialoguing partners looks like being the only way across the semantic barrier through the development of a common “*repertory*” (vocabulary, syntax and semantics) for imaging (compressing) the outside world. Plato’s noesis, as contrasted to learning from dialoguing, would thus supply a common background for the partners to share. Anyway, an ultimate universal limit of compressibility involving the material organs, as for instance the processor channel capacity and the degree of compressibility of a single sensory modality, could be envisaged. Again the shade of Leibnitzian monads would be hanging over evolutionary systems. Indeed, a limitation of information receivable by one of the partners from the other one can be shown to exist due to noise:

let  $\sigma$  be the minimum perceptible signal amplitude,  $N$  the noise level,  $(1/K)_{min}$  the minimum fraction of  $N$  such that  $N \times (1/K)_{min} = \sigma$ , and  $\Delta f$  the frequency band to which the receiving members are sensitive. We have

$$\sigma/\Delta f = N \times (1/K)_{min} \times (1/\Delta f) = \text{constant, i.e.}$$

$$(\text{error on amplitude}) \times (\text{error on frequency}) = \text{constant, or}$$

**any attempt at a higher sensitivity is to be accompanied by an attempt at an increased knowledge of the frequency of the incoming message.**

The step from nanoscale physics to macrolevel as to biosystem logic and semantics shows both of them to arise from the underlying physics of the Universe, and physical information appears to be a relational property. This supplies a cosmological support to a remark of Heinz von Förster, one among the fathers of research on self-organization:

**“There’s no such thing as self-organization”.**

## 7. Physics of Evolutionary Anticipatory Behaviour as Physics of Information

What would be, within this framework, the roots of “*molecular strategic behaviour*” as an anticipatory activity [20] experimentally validated in biological evolutionary studies [16]?

As shown above, no abstract logic, i.e. a logic living in an integrable Hamiltonian world, could be the source of such behaviour. The language levels engaged in the dialogue would live in a highly dissipative world in state space where the inequality (3) would be the source of an anticipatory logic that might be nicknamed “*dynamic logic*” by which biological systems escape infinite regression and undecidability, that acts in a closed (non-paradoxical) chain of

### sensing – information processing – actuating

embodying the system’s **syntax – semantics – pragmatics** escaping abstract logic self-referential paradoxes in self-reproduction and simulating the environment as the partner of a dialogue. The nanoscale dynamic logic would operate through the nanochaos dynamic tools – *strange attractors, stable attractors, dissipative maps, intermittency* – [4, 13 ] and nanoscale *adaptive resonant coupling* information processing [12] through ubiquitous synchronization processes [6, 9, 15] involving both partners. The strings of time series making up the dialogue would be processed into both a strong and weak anticipatory behaviour by categorization, memorization and association representable in the state space by dynamic conditions corresponding to logical space according to the following isomorphisms scheme:

in the logical space		in the state space
<i>axioms</i>	↔	initial conditions as uncompressible messages
<i>logical undecidability</i>	↔	dynamic intermittency between coexisting stable attractors
<i>deductive rules</i> (producing no new information)	↔	dynamical laws
<i>inductive rules</i> (partly novel information is produced)	↔	partly known dynamical laws
<i>memorizing /computing</i>	↔	adaptive resonant coupling (“ <i>tuning</i> ”) by Heisenberg Lie group

This concretely shows how actually any abstract logical process comes from a dynamic physical process. A highly nonlinear, dissipative and far-from-equilibrium dynamics is a necessary condition for self-contained weak/strong anticipatory properties

and the formation of novel information. But is it really novel information, or again, is novel information a delusion or physical reality?

## 8. Novelty from Dialoguing: Delusion or Physical Reality?

If Shannon's concept of information is applied to the whole Universe just like Liouville's theorem of statistical mechanics

$$\nabla \bullet \mathbf{f} = 0$$

a conservation law for information is easily obtained [13 with refs.] while information goes from the macroscopic level into microscopic degrees of freedom, that are considered entropy at the thermodynamic level. This would mean that **on the whole** within the Universe the information flow  $\mathbf{f}$  behaves just like an incompressible fluid flow, and the self-contained space mentioned above of autopoietic evolutionary systems, where  $\mathbf{f}$  becomes shrunk according to

$$\nabla \bullet \mathbf{f} < 0$$

thus behaving like a compressible fluid, would be just a *local* transitory space. No real novel information would come on the whole from dialoguing, and neither from noesis: information at our macroscopic level would be washed out by entropic degradation into microscopic degrees of freedom inaccessible to our processing capabilities.

## 9. Conclusion and Outlook: Is There any such Thing as Self-organization?

The limitations to dialoguing capabilities are anyway a condition for any sensing/perceiving systems in order not to be overwhelmed by the huge number of degrees of freedom of time series from the Universe. The capability of compressing the data of sensing into representations (laws) of increasingly smaller degrees of freedom (increasing levels of abstraction) is thus of the essence for learning and dialoguing. But the ultimate answer to the question set forth in Section 8 would ask for the development of the notion of *physical information* as a fundamental cosmological property, probably stemming from the boundary conditions of our Universe and giving the possibility of a *whole evolution* through a real physical compressible flow: self-organization and real physical novelty would arise at each moment. The present *physics of being*, built on the basis of timeless, abstract logical principles where time also is a delusion, would give way to a *physics of becoming*, whose principles would be based on a notion of information which, at the present time, is deeper than (our level) reality.

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# Water – Nanoscale to Microscale to Macroscale

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## Abstract

This paper deals with frequency and fractal related aspects of coherence in water which link the nanoscale through the microscale to the macroscale with particular reference to possible evidence for nilpotency events. It is based on the concept of domains of coherence in water. It develops work reported in CASYS'01 which showed that the basic arithmetic operations could be performed on frequency imprinted aliquots of water and in CASYS'05 where this was extended to implementation of the basic reversible logic gates. Memory in living systems, DNA and water are considered in respect of possible computer system applications and a nilpotency rule.

**Keywords:** Water, Frequencies, Coherence, Fractals, Nilpotency.

## 1. Introduction

Fröhlich investigated the properties of coherence in living biological systems as described in his Fest-Schrift. (Smith, 2006). Domains of coherence in condensed matter including water were predicted by Preparata and Del Giudice (Arani et al. 1995). Their theory gives the experimentally determined values for many of the physical properties of water including: critical volume; boiling temperature; latent heat of vaporisation; specific heat; the specific heat and compressibility anomaly at 230K; density anomaly at freezing point and the low frequency dielectric constant for water. Smith (2001, 2005) showed that arithmetic and logic operations could be performed on frequencies imprinted into water.

An emerging view is that memory in living systems, DNA and water is *quantum holographic* and *syntactic* with the information encoded in *phase* (possibly the phase of a macroscopic wave function) and operations modelled on computer '*re-write*' systems with a '*nil-potency*' rule. A quantum holographic system is the only system which places its image in the actual location of the object in space and time (Marcer and Schempp, 1998). Recent work on computer '*re-write*' systems looks towards a universal system with only a '*create*' and a '*conserve*' function which must be iterative and recursive from a '*start-object*' to a '*stop-criterion*' with a '*nil-potency*' or '*empty-set*' rule (Diaz and Rowlands, 2004).

Rowlands (2007) has described a form of expression for the '*Dirac Equation*' which contains purely physical information so that mathematics becomes an intrinsic part of physical structure. Furthermore, the equation contains three terms which separately express the "*energy*", "*momentum*" and "*mass*" in the physical system. He postulates that the most general form of the wave function is nilpotent (the square root

of zero) and the operator  $(\pm kE \pm i\mathbf{p} + jm)$  which contains the physical information about the system is also a nilpotent in which  $k$  represents energy,  $i$  represents momentum and  $j$  represents mass.

He points out that nilpotent quantum mechanics includes quantum coherence and that living systems acting as hierarchies of quantum Carnot engines could show a boundary between fractal and wave structures and evidence of chaotic working. He does not specifically write the nilpotent Dirac equation in terms of frequencies. This can be done using the relationships  $E = hv$  and  $E = mc^2$ . The momentum term could be represented by a wavelength  $\lambda$  for the coherence length in a coherent system, or by a third frequency  $= v_3/c$ . The term then becomes:

$$(\pm khv_1 \pm i\hbar/\lambda + j\hbar v_2/c^2) \quad \text{or} \quad (\pm khv_1 \pm i\hbar v_3/c + j\hbar v_2/c^2)$$

Cancelling out Planck's constant gives:

$$(\pm ikv_1 \pm i/\lambda + jv_2/c^2) (\pm ikv_1 \pm i/\lambda + jv_2/c^2) = 0$$

If the constant parameter becomes the coherence length, then frequency becomes proportional to the velocity with which the coherence propagates and frequency is now a fractal quantity.

Evidence for mass having properties of coherent frequency is seen in the spiral representation of the periodic table of the chemical elements by Stewart, cited by Rowlands (2007) in Chapter 20 and attributed to the phase of quantum coherence. Mass also appears in the work of Partheil (1861-1909) (Partheil, 1903). He studied the relationship between musical notes and the atomic weights in the Periodic Table and found that the acoustic frequency of a resonance he detected was 16-times (in Hertz) the atomic weight. Some 24 different chemical elements happened to be readily available to the present writer. Each was placed between headphone earpieces connected to an oscillator and the resonance frequency detected by dowsing. All elements gave a dowsable resonance at the audio frequency predicted by Partheil.

The physics which relates atomic weight (actually isotope mass) to frequency is the Rydberg Constant in spectroscopy but this gives frequencies in the optical part of the spectrum. If there is coherence and fractality, these should be coupling to lower frequencies. To investigate this possibility, light from a quartz-window mercury discharge lamp was imprinted into water. The frequencies were measured and the fractal ratios determined. The optical to microwave fractal ratio was  $1.1893 (\pm 0.0016) \times 10^6$  and the microwave to low frequency (ELF) fractal ratio was  $23.921 (\pm 0.033) \times 10^6$ . From the Rydberg Constant and these ratios, the corresponding ELF frequency for atomic hydrogen was found to be 16.061, in close agreement with Partheil's 16 Hz. From the writer's measurements on 24 elements, the ratio of frequency/atomic weight (C=12) gave 16.007 ( $\pm 0.021$ ). Measurements on water, deuterium oxide and single crystal NaCl gave resonances at frequencies corresponding to the molecular weights. This means that living systems have the potential for determining atomic, and molecular weights which must be an anticipatory feature for bio-chemical computing systems. It



is yet to be determined whether there is sufficient coherence in a living system for it to be able to distinguish between isotopes throughout the Periodic Table.

## 2. Frequencies in Water

For frequencies imprinted in water, experiments showed that both proton and electron spin precessions are involved whereas, for frequency imprints in metals only electron spin precession states are involved since the ions are immobilised in a crystal lattice.

A water imprint is erased if the geomagnetic field is reduced below the critical value of 375 nT. If erasure occurs when thermal energy exceeds the magnetic energy, this would occur for a spherical domain of phase coherence 52.92 $\mu$ m diameter at ambient temperature. Imprinting a frequency into water affects the natural water resonances so if this model is correct, these must also resonate with coherence domains. We showed in 1983 (Jafary-Asl et al., 1983) that living systems can respond to magnetic resonance (NMR) conditions, even at geomagnetic field strengths. Therefore, a frequency might be retained in water if proton precession becomes coherently synchronised to an applied frequency and the coherent protons generate their own internal magnetic field such as to satisfy proton NMR conditions. Such a process should be stable unless the domain is thermally broken up by removing the stabilising geomagnetic field.

The proton NMR condition gives the precession frequency  $\nu = \gamma B/2\pi$  where  $\gamma$  is the gyromagnetic ratio  $2.675 \times 10^8 \text{ rad T}^{-1} \text{ s}^{-1}$ ,  $B$  is the magnetic field and  $\nu$  is in Hz. The magnetic field  $B$  at the centre of a magnetic dipole from a rotating charge is:

$$B = \mu_0 n e \nu / 2a$$

where  $\mu_0$  is the permeability of free space,  $n$  is the number of charges  $e$  involved,  $\nu$  is frequency (Hz) and  $a$  is the radius of the orbit. Whence, the number of charges  $n$  required is independent of frequency and only depends on the size of the coherence domain:

$$n = 4\pi a / \mu_0 e \gamma$$

The number of proton charges required to generate a magnetic field to satisfy NMR conditions is  $n = 6.29 \times 10^{12}$ . With two protons available for coherent synchronisation from each water molecule,  $5.52 \times 10^{15}$  protons should be available for taking up frequency imprints and enough protons to imprint 982 distinct frequencies. It was found that water at pH 5 would accept 935 frequency imprints, whereas an aliquot at pH 9 it would only accept 77. The pH of water expresses the availability of protons and as more frequencies are imprinted, the pH increases (Smith, 2007).

The fractional bandwidth of the resonance of a frequency  $\nu$  imprinted into water is  $4.6 \times 10^{-6}$  from at least 10 MHz to 1 Hz. If the Heisenberg Uncertainty Principle is

applied to such a system having a lifetime  $t$  and there is a sufficient average number of particles  $\langle n \rangle$  for the classical concept of phase to be meaningful, then:

$$\Delta n \cdot (h\nu) \cdot \Delta t \geq h/2\pi \quad \text{or} \quad \Delta n \cdot \nu \cdot \Delta t \geq 1/2\pi$$

If the system involves random events in a continuum of time, a Poisson Distribution is applicable and then:

$$\Delta n = \sqrt{\langle n \rangle}.$$

The spectral line width  $\Delta\nu$  will be the reciprocal of the coherence time  $\Delta t$  so, for random particle fluctuations:

$$\Delta\nu/\nu \leq 2\pi/\sqrt{n}$$

Taking  $\Delta\nu/\nu = 4.6 \times 10^{-6}$ , the number of particles involved  $n = 1.9 \times 10^{12}$ . The protons involved in water memory are attached to water molecules so assuming that the fluctuation of one water molecule effectively involves three protons (two bonded protons and two H-bonded ones)  $n = \frac{1}{3} (6.29 \times 10^{12}) = 2.1 \times 10^{12}$  which is well within the present degree of experimental accuracy.

The present paper deals with the problem of the experimental aspects of water related phenomena from the nanoscale through the microscale to the macroscale with particular reference to fractal effects involving coherent frequencies and instances which may be nilpotency situations where the product of frequencies results in a **zero**.

### 3. Scales of Magnitude

At the nanoscale, enzymes are structures which show anomalous diamagnetic and Meissner type effects when in an active state and this implies long-range order equivalent to a superconducting current loop. The *lac operon* system in *E. coli* is related to effects at the DNA level and is sensitive to applied magnetic fields at the magnetic flux quantum level. Highly coherent oscillations are emitted from yeast cells at the time of cytokinesis, these are microscale structures. The macroscale structure *par excellence* is the human body. Macroscopic quantum effects occur widely in living systems and water (Smith, 2004). The imprinting and erasure of frequencies in water together with effects of frequencies on living systems are events in the macroscale region.

### 4. Chemicals' Frequency Signatures

Chemicals possessing a trace of water have a characteristic frequency pattern or signature. The ELF resonances in the n-alkanes have frequencies proportional to the chain length, but only when a trace of water was present. In n-hexane, these resonances disappear below about 14 ppm of trace water.

In general, all chemicals which can H-bond to water have characteristic frequency signatures. They are not present in 100% halogen saturated molecules such as octachloronaphthalene. These chemical signature frequencies can be copied into water and can interact with endogenous frequencies in living systems but, with no chemical content to back up the information. However, this frequency information can alter the isomeric structure of a molecule (Lubec et al., 1989).

If there are interactions involving the spectra of water and the characteristic molecular spectra of n-alkanes, these must be in the far-infra-red (FIR) rotational spectrum because this is the only place where n-hexane has any spectrum, which is the reason why it is widely used as a solvent in spectroscopy.

In considering possible water interactions with applied frequencies, it was necessary to place some arbitrary restriction on the otherwise hundreds of rotational water lines which might otherwise have had to be considered. The rotational water lines at  $28 \mu\text{m}$  ( $357 \text{ cm}^{-1}$ ),  $47 \mu\text{m}$  ( $213 \text{ cm}^{-1}$ ) and  $78 \mu\text{m}$  ( $128 \text{ cm}^{-1}$ ) can become coherent enough for use in a water vapour laser and it was concluded that these should also provide the necessary coherence for water "memory". The wave numbers of the above three spectral lines for water and the tabulated FIR spectra for the n-alkanes were used. It was postulated that the energy gap for the water resonances might be related to the differences between the water lines.

## 5. Fractality

Within a coherent system, the coherence length becomes the constant and velocity becomes proportional to frequency which makes frequency a *fractal* quantity with no absolute scale. Any velocity that the system can support will have a corresponding proportionate frequency and the frequency bands interact. It is this which links chemical spectra to technological and biological frequencies. External radiation will interact with an entire coherence domain but, because of its mass the velocity decreases to something of the order of metres per second. Thus, one finds at least two frequencies, one corresponding to the velocity of light where there is no interaction, the other to the velocity with interaction.

Measurements were made of velocities with which coherence propagates in different materials by measuring the time taken to cover a known distance using an FET transistor at each end of the specimen to interrupt the coherence propagation. Additional measurements of the critical angle at an air interface gave velocities in agreement. The measured velocity for coherence in water was 2.6 m/s and the velocity measured along a human leg was 6 m/s.

Coherence can propagate at superluminal velocity. Energy is only involved in setting up the coherence domains initially. It is detected and measured from the critical angle for total internal reflection; for superluminal velocities this appears on the air side of an air/water interface. Living systems (e.g. tadpoles and earthworms) and water imprinted at a frequency higher than a natural resonance corresponding to the velocity of light show this effect.

## 6. Fractality and Modelling n-Hexane

Because fractality of frequency in coherent systems works both ways, it is possible to model water H-bonded to a molecule and compare to the measured resonance frequencies of the chemical. Molecular models were assembled from the plastic straws of a molecular model building kit. These had a scaling of length  $3\text{cm}/\text{\AA}$ . To scale the velocities by the same factor of  $10^8$  the molecular models were immersed in saline at a concentration to give the velocity ratio: 3 m/s relative to  $3 \times 10^8$  m/s. Table 6.1 compares the frequencies for molecular models of n-hexane in saline with those for the actual chemical. The first column lists the ELF signature frequencies measured for the chemical n-hexane. The second and third columns give the frequencies measured for molecular models of n-hexane in saline. In column 3, the H-bonded water molecules are joined to carbon atoms 1 and 6, this frequency pattern matches that measured for n-hexane with trace water. It corresponds to a H-bonded water chain extending the whole length of the molecule.

**Table 6.1:** Frequencies for Molecular Models of n-Hexane in Saline

n-Hexane with trace water	Molecular Model $\text{C}_6\text{H}_{14}$	Molecular Model $\text{C}_6\text{H}_{14}$ 4 water molecules bridging $\text{C}_1 - \text{C}_6$
Hz	Hz	Hz
4.2	4.113	4.204
6.8	7.132	6.824
13	20.31	13.10
19.4	38.11	19.32
26	80.32	25.32
42		41.63

## 7. Nucleotides

Rowlands (2007) in Chapter 19 compares the fundamental processes involved in biological systems with the mathematical and physical structures essential to the 're-write' procedure with special reference to DNA, RNA and the genetic code.

### 7.1. Frequency Pattern Synthesis

Nucleotides are the monomers from which DNA and RNA are constructed. The molecules consist of a nitrogenous base, a pentose sugar and a phosphate residue. They form the 'letters' of the genetic alphabet. Each has its own specific chemical frequency signature. The frequency pattern resulting from three nucleotides can be imprinted into

'erased-water'; the water acquires the frequency pattern of the corresponding DNA-codon according to the order of imprinting. Although nucleotide sequences are encoded in the chemistry and structured into the vicinal water, it is possible to operate on the frequency signatures without any chemicals being present. This implies that the physics and mathematics of frequencies in water can be used to produce frequency signatures to match chemical structures without any chemical being present.

## 7.2. Forward Transcription

Table 7.1 lists the frequency patterns measured from samples of single nucleotides. Table 7.2 compares the frequency pattern of a tri-nucleotide chemical with that from component nucleotides imprinted into water in the same order.

**Table 7.1:** Frequency Patterns of the Single Nucleotides

Nucleotide	↑	↓	↑
Adenine	$2.043 \times 10^{-1}$	$5.610 \times 10^0$	$1.511 \times 10^{+2}$
Cytosine	$2.082 \times 10^{-1}$	$5.054 \times 10^{+1}$	$5.652 \times 10^{+3}$
Guanine	$3.212 \times 10^{-1}$	$6.365 \times 10^0$	$9.662 \times 10^{+3}$
Thymine	$2.203 \times 10^{-1}$	$6.906 \times 10^0$	$2.067 \times 10^{+2}$
Uracil	$5.872 \times 10^{-1}$	$9.211 \times 10^{+2}$	$2.926 \times 10^{+4}$

**Table 7.2:** DNA Frequency Patterns Relating to Forward Transcription

DNA Tri-nucleotide 3' - 5' CTA	$4.402 \times 10^{-3}$	$3.904 \times 10^{-2}$	$3.215 \times 10^{-1}$	$3.304 \times 10^0$	$4.313 \times 10^{+1}$
Nucleotides C+T+A imprinted into water	$4.402 \times 10^{-3}$	$3.904 \times 10^{-2}$	$3.215 \times 10^{-1}$	$3.304 \times 10^{-1}$	$4.313 \times 10^{+1}$

The frequency signatures from the DNA and the combination of separate nucleotides are not completely identical. If the tri-nucleotide and the three nucleotides as chemicals are measured together a frequency of  $7.801 \times 10^0$  Hz is detected. This frequency is also obtained if the tri-nucleotide or the three separate nucleotides (but not both together) are measured in a Caduceus coil<sup>1</sup>. The next stage for following forward transcription through water imprinting is to make a copy of the frequency signature of the DNA tri-nucleotide into water to remove the chemical component. This copy is then succeeded once in the frequency of  $7.801 \times 10^0$  Hz; a second succession brings it to the pattern of GAC as shown in Table 7.3.

<sup>1</sup> A Caduceus coil is wound as a solenoid but with a second layer of wire over-wound in the opposite sense. The magnetic **B**-fields from the two layers cancel. The vector potential **A**-fields are in the direction of the currents and are respectively clockwise and anti-clockwise giving a resultant a plane wave of vector potential which can interact with the phase of the wave function.

**Table 7.3: Succussions in  $7.801 \times 10^0$  Hz**

Once succussed DNA	$3.052 \times 10^{-3}$	$5.648 \times 10^{-2}$	$3.052 \times 10^{+1}$
Second succussion = G+A+C pattern	$2.017 \times 10^{-2}$	$6.742 \times 10^{-1}$	$4.106 \times 10^{-1}$

This imprint is equivalent to the corresponding m-RNA codon. This is then measured together with G+A+C or separately in a Caduceus coil; a single resonance at  $7.414 \times 10^0$  Hz is found. Table 7.4 shows the results from succussions in this frequency.

**Table 7.4: Succussions in  $7.414 \times 10^0$  Hz**

Once succussed m-RNA	$3.051 \times 10^{-2}$	$5.915 \times 10^{-1}$	$4.119 \times 10^0$
Second succussion = C+G+U = t-RNA	$4.603 \times 10^{-2}$	$5.018 \times 10^{-1}$	$5.716 \times 10^0$
Third Succussion = aspartic acid	$2.501 \times 10^{-3}$	$2.007 \times 10^{-2}$	$2.007 \times 10^0$

Note that several frequencies around 7.8 Hz appear in the above Tables. This frequency seems to be a general promoter for changes to water imprints. It is also the endogenous frequency of the heart meridian and chakra and it appears in Schumann Radiation from the ionosphere under which evolution has taken place.

### 7.3. Reverse Transcription

Succussions using different frequencies will take the amino acid frequency pattern in water back to that of the DNA. Firstly, measure the amino acid chemical and the above water imprint together or separately in a Caduceus coil. This gives the promoter frequency for the reverse transcription as  $3.151 \times 10^0$  Hz. Table 7.5 lists the results of a series of single succussions in this frequency.

It appears that the application of the physics and mathematics of frequencies in water will take patterns of coherent frequencies through the paths that would be followed if the actual chemicals had been present to H-bond to their vicinal water.

**Table 7.5: Succussions in  $3.151 \times 10^0$  Hz**

First succussion of amino acid imprint in water = C+G+U =t-RNA	$4.603 \times 10^{-2}$	$5.018 \times 10^{-1}$	$5.716 \times 10^0$
Second succussion	$3.051 \times 10^{-2}$	$5.915 \times 10^{-1}$	$4.119 \times 10^0$
Third succussion = G+A+C	$2.017 \times 10^{-2}$	$6.742 \times 10^{-1}$	$4.106 \times 10^{-1}$

Finally, the result from the third succussion is measured in a Caduceus coil (or with G+A+C) and this gives  $7.810 \times 10^0$  Hz again. Succuss once at this frequency and the amino acid water imprint is found to have returned and to be the same as the five frequencies listed in Table 7.2.

## 8. Nil-potency

This section attempts to identify systems and measurements which might be used to investigate nil-potency. The criterion used is that the product of two operations shall result in a **zero**. Effects are found in the process of potentisation and in the 'Three Courses' of the acupuncture meridians.

### 8.1. Potentisation

Experiments on the imprinting of water by *succussion* (i.e. mechanical shock) using a free-fall ampoule of water showed that momentum change rather than energy change was involved (Smith, 2008). The nil-potent equation contains a momentum term.

When water is imprinted by succussion with 10 Hz the water resonance frequencies become **zero** and are replaced by two sidebands at  $\pm 10$  Hz in the ELF. The GHz and THz fractals are replaced by proportionate sidebands.

When water is imprinted by succussion at 1 Hz and then serially diluted tenfold (1+9): the 1 Hz remains. When it is succussed - the 1 Hz **disappears** to be replaced by 10 Hz. In general after succussion, the original frequency **disappears** to be replaced by that frequency multiplied by the dilution factor. However, a 7-fold dilution does not potentise and gives the pattern of the 6-fold dilution; the 11-, 13- and 19-fold dilutions do not imprint any frequency - **zero imprint**. These are all prime number dilutions. The same thing happens for these dilution ratios multiplied by 10, 100 and 1000.

### 8.2. Organs and Meridians in Chinese Acupuncture

Chinese acupuncture recognises 11 organs in the sense of them being general structural and functional entities. There are 6 Yang organs and 5 Yin organs which interact closely with the 'channels' or 'meridians' serving them. There are 12 meridians running parallel to each other in the limbs and these are paired into Yang which is characterised by exterior, excess, heat; and Yin which is characterised by interior, deficiency, cold (Stux and Pomeranz, 1991). With two median meridians these make up the 14 meridians on which the 361 'Classical Chinese Acupuncture Points' are located.

The 12 meridians are divided into 'Three Courses' through which 'Qi' or bio-information is supposed to flow. The frequency measured when pairs of Yang or Yin meridians are joined with a wire connected between a pair of acupuncture points is the geometric mean of the high and low frequency on each Yin or Yang branch.

If the frequencies of a Yin and a Yang branch are imprinted into separate vials of water, with the Yin and Yang imprinted in opposite phases and the vials are then placed close together so that the wave functions overlap, **no frequency can be measured**. This is a situation in which the products of frequencies give a **zero** resultant.

If three of the four frequencies of a Course are imprinted into a single vial of water, any attempt to imprint the fourth frequency **erases all the frequencies**. This is clearly an **anticipatory** system whereby in the normal or healthy state, the frequencies

around a 'Course' are **nil-potent**, but if any organ within the 'Course' changes its frequency from its healthy endogenous nilpotent value, an alarm frequency will appear.

## 9. Conclusions

Fractality of frequency in coherent systems links the nanoscale through the microscale to the macroscale in water, DNA and living systems. Nilpotent effects may occur on the basis of the product of two operations giving a zero outcome and provide the system with an anticipatory feature through the appearance of an error signal when nilpotency ceases. A coherent frequency is the basic instruction. A physical mechanism for the memory of frequencies in water is presented. As shown in previous CASYS papers, frequencies imprinted into water can be processed arithmetically and operated on by the basic reversible logic gates. The operations are clocked by voltage pulses which can be as small as nerve impulses so these operations are available to living systems. Frequency erased water would be a suitable medium for a 'create function'. A 'start-object' might be a frequency imprinted into this water. Frequency "memory" would be the 'conserve' function. Erasure would be the 'stop-criterion' and nilpotency would provide both an anticipatory feature and remove redundant information.

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