

# **SCIENCE AND CONSCIOUSNESS: MODELS AND CHALLENGES**

**ASSEN I. DIMITROV**



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## Foreword

I don't know why books should be written about things that could be told in a few lines:

*Just the sleeping Nature awakens and regains consciousness. This happens as a result of an 'informational collapse' due to the accumulation of a super-critical amount of information in an intelligent subject.*

That's all I have to say on the issue of the nature of consciousness. And, the prerequisites of this hypothesis are set out below, namely:

- Aristotel Gavrilov's conception of the nature of consciousness as an open window of the subject towards the objective reality;
- Claude Shannon's and Léon Brillouin's conception of the nature of information as removed uncertainty;
- As well as an account of my wanderings, in search and trial of different approaches to a plausible solution to the problem of the nature of the mental states.

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Consciousness is not something; in actual fact, it is nothing. That is to say, I accept Aristotel Gavrilov's idea that consciousness is just an open window of the subject towards objective reality.

Consciousness or awareness is the event in which a window of the subject towards objective reality is being set ajar; a window is crack open through which the subject obtains an informational access to reality and thus an ability and means of cognition, respectively knowledge about it and control over it.<sup>1</sup>

Coming to consciousness is the opening of the information window of the subject to objective reality that to an insentient object is closed.

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But who and when does open this window? What is the physical meaning of this metaphor?

Two options are be explored below and beyond this account.

1. One option is that the window of the subject towards reality opens at the so-called (equilibrium or

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<sup>1</sup> Consciousness is not something. It is an event. It is the event of the opening of the informational window of the subject to objective reality in equilibrium or nonequilibrium phase transitions. A reduction of probabilistic uncertainty is carried out in these phase transitions that from an informational point of view is equivalent to a net gain of information.

nonequilibrium) phase transitions, where the probabilistic uncertainty of the system's thermodynamics is reduced, which in itself is equivalent to a net growth of information;

2. The other option is that this is done at an event, which was already referred to as an 'informational collapse'.

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We can see that the metaphor is literally valid. The window was closed with the blind of thermodynamic probabilistic uncertainty - the entropy. The reduction of entropy in phase transitions raises the blind and the window of the subject to objective reality becomes transparent and open.

Another hypothetical solution is that the informational openness of the subject towards objective reality occurs at the so called 'informational collapse.' This collapse takes place when the accumulated supercritical amount of information is energetically equivalent to the magnitude of the mass, wherein a gravitational collapse occurs.



## General annotation of the enquiry

The first part of the book offers a hypothetical answer to the following questions:

What is intelligent behaviour?

What is information?

How does the intelligent subject extract energy and information from the external environment?

What are the mental states?

How do the mental states occur?

Despite the immense diversity of disciplines, topics and issues relating to the structure and the dynamics of the nervous system, of human consciousness, of intelligence in a synchronous and evolutionary perspective, two main philosophical and theoretical ideologemes stand out in the neurosciences of today: the computational and the holonomic one. They are presented in the second part of the investigation.

The third part is entirely focussed on the semiotic approach to the study of intelligence. Particular attention is paid to the issue of the missing link between natural causality and intelligent behaviour, to which it offers a particular reply.

The fourth part is itself a summary in the perspective of the conclusions of the previous parts.

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A book should possess not only content, but also a plot, that is, each successive event is to be caused or motivated by the previous ones. Of course, new characters and events that so far have been away from the subject line appear constantly. But the plot must

entrain them into the mainstream and its logic. Otherwise, we don't draw up a thesis but write a reference book. So, my intent is that each chapter should answer a question posed in the previous and formulate a question to the following ones.

Last but not least, I had to sacrifice the eloquence of the presentation for the accuracy of its reception.

*Keywords: mental states; information; entropy and negentropy; energy and information; informational collapse; computation; biocomputation; holonomic paradigm; semiotics; causality and semiosis; electromagnetic induction; signal transduction; adaptive behaviour; intelligence*

## INTRODUCTION: THE PROBABILISTIC MATRIX OF REALITY AND ITS INFORMATIONAL INTERFACE

*Synopsis:*

*This section will detail the thermodynamic preconditions of conscious awareness; together with the problem of how we perceive and become aware of the objects, we will pause on another intriguing problem - how do we give rise to our actions by means of our thoughts?*

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*It is not solid physical structures that lie in the foundation of objective reality, but merely probabilities and superpositions among them. The solid structures of our sensorial and practical experience are an outcome of the collapse of probability functions as a result of physical measurement and perhaps, even - sensory observation.*

*While in causal processes energy is applied to alter the existing spatial structures, information processes employ energy for the conversion of the probability distributions of the systems' dynamical states.*

*There are equivalences and mutual conversion of mass, energy and information. Mass, energy and information are just three appearances under which probability communicates with us.*

*From the above frame of reference, we shall consider a hypothetical answer to the questions:*

*What is probability?*

*What is and what does the process view on information disclose?*

*What is the cognitive (the mental) image?*

*What are the equivalences and mutual conversions  
of mass, energy, and information?*

*How do our thoughts bring about our actions?*

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## Key assumptions and key issues

Before proceeding to the main themes and issues, here are the main assumptions, on which the exposition is based:

1. Probability is uncertainty.
2. Information is that, which removes uncertainty.
3. Uncertainty is removed at the so-called 'equilibrium' and 'nonequilibrium' phase transitions.
4. There is equivalence and mutual conversion of energy and information.

Here are the key issues that will be discussed below:

1. What is probability?
2. What is information?
3. What are the mental images?
4. How do we cause our actions by our thoughts?

And here are the keywords: *probability, information, phase transitions, mental images, Toyabe experiment, mind body problem.*

1. Everything is probability.

- 1.1. Simple maths of probability

Insofar as the term 'probability' is a key to the theses presented herein, we shall start with its brief

explication. Probability is a measure of the likelihood that an event will occur. It is calculated by the formula  $P = \frac{1}{n}$ , where  $P$  is the probability, and  $n$  is the number of all possible, equiprobable, outcomes of a state of affairs. Most often, the calculation of probability is illustrated by the game with a 'clean', i.e., unbiased coin. Insofar as it is assumed that the production of 'heads' or 'tails' are equally possible events, the likelihood for any of them to occur is  $P = \frac{1}{2}$ . Measured in percentage, in this case, the probability to hit 'heads' or 'tails' is 50%. It should be noted that probability is a number from the interval  $[0, 1]$ , which is designated as follows:  $P(A) \in [0, 1]$ . The square brackets mean that 0 and 1 are included in this interval. The impossible events are denoted by 0, and by 1 - the events that will necessarily happen. (Wikipedia 2015)

## 1.2. Solid matter is falling apart before our eyes.

### *Synopsis:*

*It turns out that reality is not made out of solid state structures but rather out of objective probabilistic states. The deep substantial matrix of objective reality is probabilistic. It is not solid physical structures and interactions between them that underlie physical reality, but rather - objective probability states and superpositions among them. The structures of our sensory and practical experience are a product of the collapse of probability functions as a result of physical measurement and perhaps even of sensory observation.*

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Mechanics is this branch of physics, which in recent centuries determines the relationship of science (and not only science) to determinism. Absolute or Laplace determinism reigns in classical mechanics. The advent of quantum mechanics in the early twentieth century radically changed the picture of the events in the micro world, which are now viewed as entirely probabilistic functions.

Even with the introduction of the quantum-mechanical model of the atom, it was portrayed as a nucleus of protons and neutrons, and a probability cloud of electrons hovering around it. If the nucleus is displayed with the size of a tennis ball, then the electron cloud will hover at about 20 km away from it. It is emptiness between them. So, the vast, the major part of space occupied by the 'solid', 'indivisible', 'impenetrable' atom is empty. Before ourselves we see hard, impervious, solid macro-physical objects. In reality they are hollow; in their prevailing volume they are void space. That's not all. The electron cloud itself is not a saturated, even though amorphous mass, as it should be expected from a 'cloud.' It is a matter of a probabilistic quantum-mechanical system without an analogue in the macro world we are used to perceive with our senses. Therefore, it is impossible to give even a metaphorical description of this quantum-mechanical model. In general, it can be described with mathematical formulas as the Schrödinger function. It is usually said that the electron cloud is a superposition of all its possible probabilistic states. In such form, the electron exists so far as it does not become an object of observation or more accurately speaking - measurement. Subjected to

such physical procedure, because measurement necessarily involves a physical impact over it, the electron collapses into and behaves exactly like a corpuscle, known from classical mechanics. To continue with the atomic nucleus, it, however limited and sub-microscopic in volume, again doesn't behave like a classic solid from our macro world and displays the quantum mechanical probability dynamics inherent in the electron cloud. Below, at the level of quarks or strings, things become even more fuzzy and abstract for us to be able to assign them some real physical content and meaning inherent in the categories of solid material objects in which we think and perceive our macro world.

Probability wave functions - that's what after all remains out of what's called 'objective reality'.

The density of matter is actually a density of the probability distributions of the localization or the actualization of each fragment of objective reality.

## 2.1. The simple maths of information

is given in Shannon's celebrated formula:

$$H = -\sum P_i \log_b P_i,$$

where  $P_i$  is the probability of character number  $i$  showing up in a stream of characters of a given 'script'. (Wikipedia 2015)

What we do make out of the above formula is that:

- Information is a direct offspring of probability;
- The lower the probability for an event to occur, the higher the quantity of information it provides;
- Information is neg-entropy, that is - removed uncertainty.

Further, we shall emphasize mainly on the latter quality of the information - neg-entropy, i.e. removed uncertainty. Information is that, which removes uncertainty. For this reason, further we'll discuss precisely the mechanisms, the processes that lead to the reduction and elimination of probabilistic uncertainty.

Here, one cannot help but recall the words of Michelangelo: 'Every block of stone has a statue inside it and it is the task of the sculptor to discover it.' And, especially his aphorism: '*It's simple. I just remove everything that doesn't look like David.*' These great words hardly need a comment of ours. So, let us, before getting back to them briefly, now proceed with a

## 2.2. Simple physics of information

In view of the subject discussed here, there are two types of physical interactions:

- Interactions that result in the change of the *spatial patterns* of the object of their impact; such processes we usually denote as 'causal interactions' (e.g. I break a glass, or I tear a sheet of paper, etc.);
- Interactions that alter the temporal patterns of the occurrence of an event.

In particular, the latter interactions are phase transitions, such as: change in aggregate state, changing seasons, self-organization, etc.; or it can be a qualitative transition in a social dynamics associated with its evolution or revolution.

What is important is that, in the latter occasions, the energy of the interaction is not employed to change the structure of a system, but rather the structure of the probability distributions of its dynamics over time.

## 2.3 Phase transitions reduce informational uncertainty



Uncertainty in physical systems is removed either through the addition of external energy into the system, i.e.  $+\Delta E$ ; or through the removal of internal heat out of the system, i.e.  $-\Delta Q$ .

Hence, phase transitions are nothing but a physical mechanism of removal of uncertainty, or in other words - entropy (randomness, disorganization) - out of the dynamical physical system.

Thus, to return for an instant to Michelangelo's iconic phrase, thanks to the informational physics of thermodynamic phase transitions, the greatest artist and the greatest sculptor, by far, remains to be Nature.



*Fig. 1. Spiral iceberg in Antarctica*

<http://www.youramazingplaces.com/12-stunning-photos-of-places-decorated-with-the-most-beautiful-element-water-in-solid-state/>

### 3. Information and mind

To summarize what has been said so far:

Information is reduced uncertainty and phase transitions in real systems are the mechanism that actually carries out this reduction. As a result, conditions to achieve a special state of 'informational openness' arise in the system that has undergone such informational dynamics. This will be discussed shortly. Now, we continue with

### 3.1. Gavrilov's thesis:

As the outstanding Bulgarian researcher of consciousness, Aristotel Gavrilov, put it:

Consciousness has no content of its own. The mental image is not a picture of an object, but an open window through which we observe this object.

'Mental images', in the sense of some material or ideal representations of the objects of our observation, do not exist. For, if such representations mediating the observed objects did exist, they would not reveal, but rather would obscure the authentic content of the objective original.

*The cognitive image is an open window to the objective world.*<sup>2</sup>

The process view of information is a good physical basis of Gavrilov's thesis. This thesis is totally in line with the view, according to which information is the process of:

- changing the structure of the probability distributions of a dynamic occurrence,

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<sup>2</sup> The idea can be tracked down as early as in Locke - *tabula rasa* - the mind in its hypothetical primary blank or empty state before receiving outside impressions.  
( <http://www.merriam-webster.com/dictionary/tabula%20rasa>)

- through nonequilibrium or equilibrium phase transitions,
- thereby removing its inherent probabilistic uncertainties,
- and accordingly reaching an informational transparency (openness) to the objects of our knowledge and action.

### 3.2. How do our thoughts cause our actions?

For sure, we have more than serious reasons to look with irony at 'para-phenomena' as 'telekinesis' and 'levitation'. But the reasonable question remains: 'How do our thoughts cause our actions?' How is it for instance, that by the force of the intellectual act of will, I manage to raise my hand? Because, whether the power of consciousness will cause changes in the outside world or in our own body and our own physical activity is quite insignificant from the standpoint of philosophical theory. In both cases - the first is as dubious as the second is unambiguous - it is a matter of causing physical acts with the power of human mind.

It seems however that today's physics of information can offer a hypothetical answer to this typically insoluble, 'metaphysical' question. Generally, the answer consists in the recently, empirically confirmed, equivalence and mutual conversion of energy and information.

In fact, so far we have dealt in a good level of detail with the first conversion - that of energy into information. It consists in the fact that there are physical processes in which energy is employed in the change of probability distributions rather than of spatial structures. These same processes called 'phase transitions' reduce thermodynamic entropy in real systems and therefore can reasonably be seen as a process of production of

information or in other words, the conversion of energy into information<sup>3</sup>.

But, the great news came in 2010, when the team of Prof. Shoichi Toyabe succeeded to demonstrate empirically the transformation of information into energy.

### 3.3. Prof. Shoichi Toyabe's experiment

In the description of their experimental setting, the investigators refer to the famous thought experiment with the Maxwell's demon. In it, a microscopic intelligent being is able to extract energy from an isothermal gas. - Thanks to its knowledge of the dynamics of all gas molecules, the demon, through a valve controlled by it, separates the hot particles in one compartment of the device and the cold - in the other.

In the experimental setup used by the Japanese scientists:

- a nanoparticle with a diameter of 0.3  $\mu\text{m}$ ,
- climbs up a spiral staircase-like energy potential,
- only due to informational control,
- without any external energy to be applied to the particle.

"In 1929, Leó Szilárd invented a feedback protocol in which a hypothetical intelligence—dubbed Maxwell's demon—pumps heat from an isothermal environment and transforms it into work. After a long-lasting and intense controversy it was finally clarified that the demon's role does not contradict the second law of thermodynamics, implying that we can, in principle,

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<sup>3</sup> For instance, when ice is melted, a definite quantity of energy is used not for the raising of the temperature of the ice lump, but exclusively for the transformation of its aggregate state, which means nothing else but a change of the patterns of the thermal fluctuations, that is, the probability distributions of the dynamics of the water molecules.

convert information to free energy. An experimental demonstration of this information-to-energy conversion, however, has been elusive. Here we demonstrate that a non-equilibrium feedback manipulation of a Brownian particle on the basis of information about its location achieves a Szilárd-type information-to-energy conversion. Using real-time feedback control, the particle is made to climb up a spiral-staircase-like potential exerted by an electric field and gains free energy larger than the amount of work done on it. This enables us to verify the generalized Jarzynski equality, and suggests a new fundamental principle of an ‘information-to-heat engine’ that converts information into energy by feedback control.” (Toyabe 2010)

It happens like this:

By virtue of its spontaneous thermal fluctuations, the particle oscillates continuously between levels with higher and lower energetic potential. The information control of the particle’s behaviour consists in the fact that when the particle occupies a higher level, an energy barrier is switched on that prohibits it to revert to a lower energy state. The same procedure leads the particle to climb the next energy stair and so on, until the particle occupies the highest level allowed by its spontaneous thermal fluctuations.

“The experiment consisted of a 0.3  $\mu\text{m}$ -diameter particle made up of two polystyrene beads that was pinned to a single point on the underside of the top of a glass box containing an aqueous solution. The shape of an applied electric field forced the particle to rotate in one direction or, in other words, to fall down the potential-energy staircase. Buffered by the molecules in the solution, however, the particle every so often rotated slightly in the opposite direction, allowing it to take a step upwards. By tracking the particle’s motion using a video camera

and then using image-analysis software to identify when the particle had rotated against the field, the researchers were able to raise the metaphorical barrier behind it by inverting the field's phase. In this way they could gradually raise the potential of the particle even though they had not imparted any energy to it directly.” (Cartlidge 2010)

A comprehensive interpretation of the experiment from the viewpoint of the philosophy of information is presented in “The Digital World - Construction and Reality” (Lazarov 2015).

### 3.4. So, what makes us raise our hand?

The answer comes by itself taking account of the equivalence between energy and information, and in particular that the acquisition of new information can contribute to the increase in the body's energy potential.<sup>4</sup>

Mental states:

- either spontaneously ‘absorb’ information in their capacity of sensorial acts;
- or, they produce information in their capacity of intellectual acts (e.g. logical operations).

Thus, perhaps the information acquired on purely cognitive terms may eventually be converted into enough energy to switch on the control levers of our behaviour? Once we have reached a state of conscious awareness, i.e. informational openness to the world, the information acquired on purely cognitive terms may eventually be converted into enough energy, sufficient to switch on the control levers of our behaviour?

To sum up, here are the answers to the questions posed in the Foreword:

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<sup>4</sup> In this case, it is clear that any mental decision is related to a solution of a problem, which in itself should contribute to the raising of the information potential of the intelligent agent.

### 1. What is probability?

Probability is a measure of the uncertainty of complex dynamical systems. On the micro level, reality is nothing more than a superposition of objective probability states.

### 2. What is information?

Information is a process. It is the process of reducing the uncertainty of complex systems' dynamics, which takes place at their equilibrium and nonequilibrium phase transitions; a simple example of such a transition is a change of the aggregate state. In these phase transitions, the energy of the interaction is not employed in changing the present physical state of the system but in the change of the structure of its probability distributions; besides, that change does not manifest itself immediately, but only in its subsequent dynamics.

### 3. What are the mental images?

Mental images are an open window of the subject to the objective reality. Mental images are a state of informational openness of the reality for the subject, arising from a reduction of the probabilistic uncertainty in the complex phase transitions of the subject's dynamical communication with reality. A more detailed exposition of the particular mechanism of mental states' emergence, however, will be elaborated elsewhere.

### 4. How do we cause our actions by our thoughts?

There is a mutual conversion of energy and information.

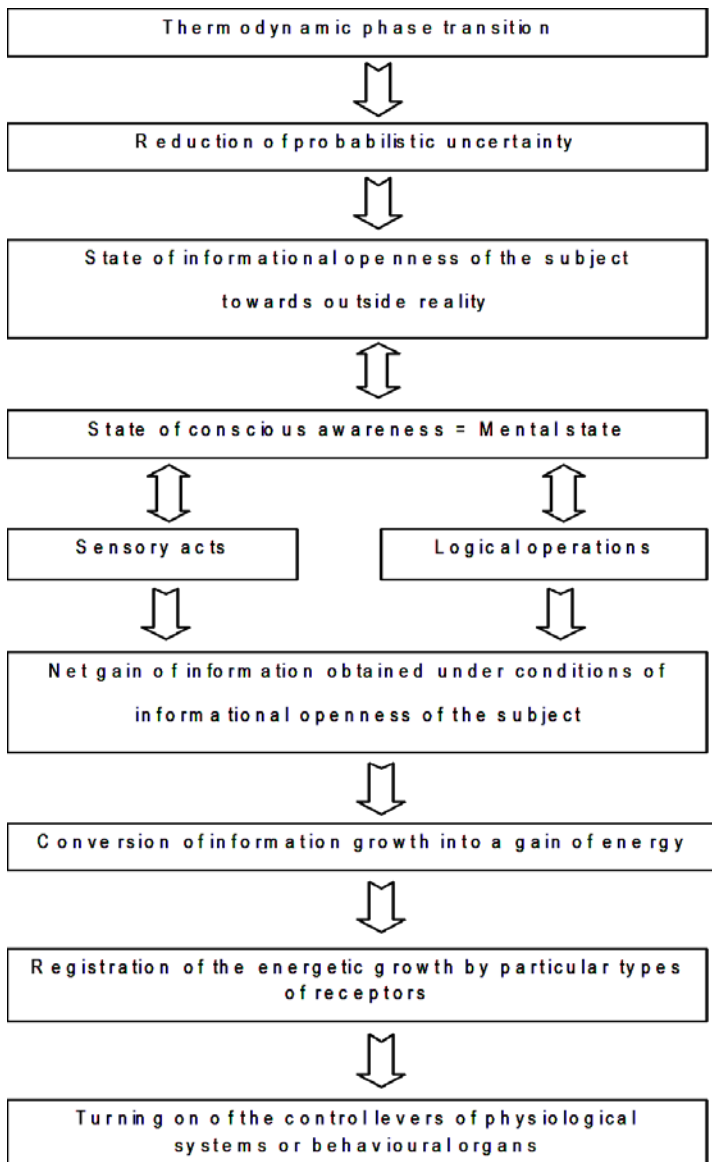
In the first case, this is a matter of the employment of energy not for the change in the particular physical state, but for the change of the structure of the probability distributions of a certain system's dynamics.

The second case was empirically confirmed by the experiment of Prof. Shoichi Toyabe (a materialization of the fabulous Maxwell's demon, achieved by means of modern technology), where the purely informational



control of the dynamics of a nanoparticle (i.e., without applying external energy over it, but only by imposing restrictions on the structure of its spontaneous probabilistic thermal fluctuations) leads to the increase of its energetic potential.

But then it is clear that the net growth of the information gained from the state of informational openness of the subject to the world, should lead to a net increase of energy in the subject, which would be sufficient at least to switch on the control levers of its physiological systems or effector organs. For example, the net energy growth obtained in the state of informational openness of the subject (which is due to the reduction of probabilistic uncertainty produced under thermodynamic phase transition) would probably provide enough energy to be registered by a certain type of receptors. The activation of these receptors is already enough to bring us into the course of well-studied mechanisms of behavioural regulation. The whole problem is how can these receptors be switched on only 'with the power of thought'? Modern physics of information, thanks to the crucial Toyabe experiment already seems to have readiness to give a specific reply. 'Physical activity caused by the power of mind' actually means the following sequence of processes:



*Fig. 2. Mental causation - a hypothetical scheme*

Discussion:

One could question whether the state of informational openness is a necessary prerequisite for obtaining a net gain of information. Such growth of information may also occur in the initial phase transition, wherein the physical energy is introduced solely for the alteration of the structure of the probability distributions of a certain dynamics, which in itself can be regarded as the production of information. In other words, the initial thermodynamic phase transition can be seen as a process of conversion of energy into information. Accordingly, the energy produced at the second conversion - of information into energy - could be detected by certain receptors, and thereby - turn on a particular behavioural chain.

In this case, however, the state of informational openness would be unnecessary as a conscious volitional control over our behaviour, and the latter would be reduced to a standard causal chain based on mutual conversion of energy and information.

Besides, it is not clear whether the state of entropy reduction (reducing the probabilistic uncertainty) leads to a state of informational openness as well. Otherwise, we should expect that a similar openness to information is available to any non-equilibrium thermodynamic system. Actual informational openness, in our judgment, arises only at particularly high levels of accumulation of information, especially at a specific phenomenon called 'informational collapse', to be considered further in this piece of writing.

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## PART I: MENTAL STATES

### Chapter 1: What is intelligent behaviour?

#### *Synopsis:*

*The control over the things and the knowledge about them are inseparable. The cognition of the things is a hierarchical act. Consciousness is an instrument of control of the subject over its world.*

*The control and ascending above the world of things is a prerequisite for their understanding and cognition.*

*To know the things, the subject must first rise above the causal hierarchy of the objects; it must tear itself away from causal determinism; it has, in the most literal sense, to escape, to rise above the object; to become free of it and in its turn to subject it and turn it into its own object and instrument.*

1. The ontic schism: knowledge, hierarchy and control

That subject and object are fundamentally different is as obvious as it is generally recognized by the majority of philosophical stands and approaches. We shall note only that this fundamental opposition is not just a fact; it is a prerequisite for them to be what they are, and in particular - to allow the subject to perform its fundamental ontological and epistemological function. This function is not limited to knowledge and to experience in general, but we shall mainly address them - in their quality of mental states.

Indeed, the subject should be off to an insurmountable distance from reality to be able to enter into a radically new type of ontological relationship with it. This type of ontological relationship becomes possible

only when the subject is already able to attain freedom from the natural causal links that carry it back, reduce and degrade it to the blind, unintelligent submission to causal determinism. Once that it has lost this freedom and is caught back into the grip of the causal links, the subject loses its intelligent ontic aura and becomes an ordinary, indistinguishable from the others, physical object. Awareness, experience in general, is an act of separation of the subject from objective reality. The subject is detached from it; it rises beyond reality - this is a non-alternative precondition to turn reality into an object and content of its reflection. This detachment is not a metaphor; it is a matter of a deep rift with causal determinism; the ontic schism between the subject and the object is not only an ideological construction but a real physical fact. If the subject was not able to actually differentiate, and that means not only in an axiological, ideological, or ontological sense, but in a literal and strict physical sense, it would not be any subject, but just another of the countless physical objects blindly managed by physical causality. Its relation to reality would be causal and not free, cognitive, constructive, based on values; not intelligent.

Another tacit premise is that the knowledge of things is a hierarchical act - the problem of consciousness is inseparable from that of freedom and control. The problem of consciousness has a hierarchical solution - mind is an instrument of control that the subject exercises over its world. In order to tear the subject away from causal determinism, to set it free, it must first rise above the causal hierarchy of objects; it must in the most literal sense escape, rise above the reality of the objects. That the subject sees, realizes the object is only the effect. The underlying cause is that it has already plucked out from the obedience to causality.

An asylum and a new command position over the world of physical objects, the subject finds in a new, imaginary, semantic dimension, supplemented to the four-dimensional physical continuum.

## 2. Gavrilov's thesis

Consciousness has no content of its own. The mental image is not a picture of an object, but an open a window through which we observe this object. Consciousness is a particular relation of the subject regarding the object in which the object is revealed to the subject in its authentic nature.

## 3. What kind of relation can this be?

The answer is in what the function of consciousness might be. Here, two of its features can be emphasised:

- One is control: Mind is the instrument through which the subject achieves two objectives; one is to get away and become independent of the causal laws of the physical world, a part of which the subject itself is; the other is something more than that - to stand over and control the physical causality and physical reality as a whole.
- The other function is epistemological: the subject must ascend beyond, break away from physical reality in order for the reality to stand in front of it, i.e. to become an object, subject-matter of its perception.

We see that for both aims and objectives, the means is a separation, departure from causal reality. Basically it is a hierarchical staging - the subject should stand above the object reality in a figurative, hierarchical sense and in a literal - epistemological sense. Perception as a cognitive attitude is only a consequence and subsequently an instrument of the relationship of subordination and control - the hierarchical relationship.

The hierarchical relation is what Gavrilov speaks about; it is the attitude of control and awareness. In it, the subject of knowledge is detached from causal reality and stands above it; thus the subject assigns to itself an exterior content which it experiences as its own inner state.

What this inner state is and how it can be reached - this is the central storyline in the book. The other major plot threads will occur in the second and the third book's parts.

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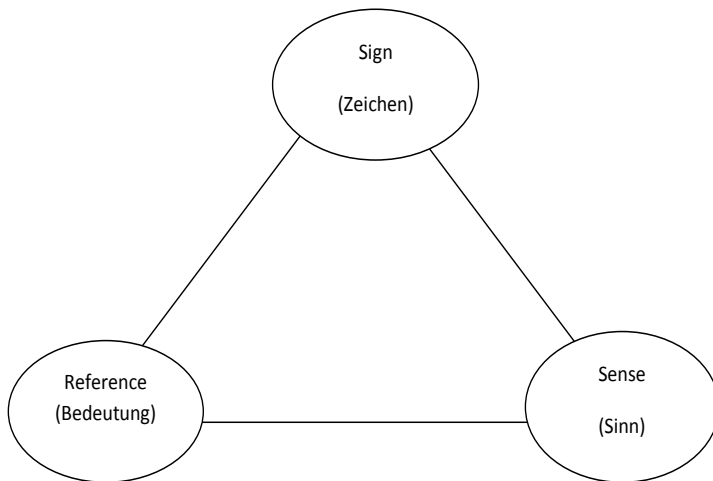


## Chapter 2: What is information?

*Synopsis. The category information - projected onto the semiotic triad:*

*The category 'information' is interpreted on the basis of the semiotic representation of reality (Frege's and Ogden&Richards' triangle) separating it into: signs, meanings and concepts (senses). When we talk about information in the sense of some news, some knowledge about an object or an event, it refers to the semantic, conceptual side of the semiotic triad. When we talk about the information as a signal flowing along a channel of communication, non-relatively to its source and to its recipient, that message (information) is nothing but a set of signs (characters, symbols). As to the objective referent of the informational processes, the latter are physical interactions associated with the change and the control over the probabilistic distributions of the spontaneous thermal fluctuations in thermodynamic systems.*

When talking about information, often completely different things are meant: some knowledge, a database, or a message, news...; Shannon's information theory defines information through concepts such as probability and entropy - or rather negative entropy - negentropy (Brillouin 1966); hence, with reason, the understanding of information is inseparable from that of order. All these notions of information have their grounds and their relevance; the question is to establish unity and unambiguousness in the use of this term. In such cases, the semiotic approach is useful and reliable, and Frege's triangle - a universal and comprehensive model; not only in this case, but practically everywhere we want to give a - clear enough as content and precise as a sense - definition.



*Fig. 3. 'By means of a sign we express its sense and designate its reference.' Frege (1892)*

To take an example: we want to give a definition of 'a tree'. Then clearly, under Frege's scheme, it is seen that:

- 1) 'tree' is a linguistic sign, which denotes
- 2) a certain real object, called by us 'tree'; this object in Frege's scheme is called 'meaning', or 'reference' and
- 3) besides the sign and its meaning, we have a certain knowledge, concept about the tree; in Frege's scheme this concept is referred to as 'sense'; the sense is this concept that we gain about the object designated by the sign, once we have already decoded, i.e. interpreted that sign.

To put it even more succinctly: 'tree' is a linguistic sign; 2) the image, the thought, the concept of 'tree' is what Frege called sense; 3) the real object, existing independently of our knowledge about it and its designation by us, Frege called reference or meaning.

Now to refer the term 'information' to the semiotic triangle:

1) First of all we must distinguish its sign. This is nothing other than the carrier of the information - a data signal. Data carriers are really endless, beginning with physical processes and arriving at linguistic structures (verbal or textual); besides, they often move from one form to another and form indefinite in length signal chains before they reach their interpretation.

Once the information (here - the data signal) is interpreted, we come to its meaning and its sense.

2) As for the meaning of the information signal, as already hinted, here we shall accept such an objective reference: a real order in the world, existing outside and independently of the process of the information communication. The nature of this order will be discussed in more detail shortly.

3) As for the sense of the information signal, it is obviously the knowledge that we gain, after this signal has reached us in the event that we are able to interpret it correctly. In Shannon's theory of information, the interpretation of signals is quite simple - each signal carries a predefined response to a question that can be answered only with 'yes' or 'no.' Such was the signalling ('telecommunication') of the ancients, where the occurrence of fire or its absence in a particular place could really mean a lot. By the same extremely simple, binary code work computers, and indeed most today's media and telecommunications systems.

So, there is no ambiguity or dispute whether information is knowledge, or a printed text, or a database, or as implicitly the theory of complexity assumes - a structural or dynamic order. These are only different perspectives of the category information revealing themselves, however, from the different vertices of Frege's triangle.

As noted, the category 'information' can effectively be interpreted on the basis of the semiotic representation of reality (Frege's triangle) separating it into: signs, meanings and concepts (senses). When we talk about information in the sense of some news, of some knowledge about something (an event or an object), it refers to the semantic, conceptual side of the semiotic triad. When we talk about information as a message flowing along a channel of communication, non-relatively to its source and to its recipient, that message (information) is nothing but a set of signs (characters, symbols).

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More difficult, however, is the issue of what information is beyond and independently of the communication and its addressees. Obviously, behind the information as knowledge and information as a signal stands some objective reference. But we mean not just whether such reference is out there, but what in particular, it might be? Of course that in an everyday word usage, the reference of 'information' can be any subject, object or event. But such word usage cannot lead us to a deeper understanding of information, let alone to any management, control or practical, say technological application of or through the real information dynamics. In order that such a goal is achievable, information should interest us as physical quantity - like mass or energy; a magnitude that can be registered and measured, and ultimately to create technological applications based on its management and control in our interest. Fortunately, the development of physics overcomes the classic Augustine shock and

bewilderment how to answer the question: 'What is information?' Today, physicists have quite a specific answer to this question. Of course, in practice they do not deal with categorical explication of the term; often that would make it even more difficult to define it. What is certain is that in its most common and probably most adequate use, information is interpreted in terms of thermodynamics and probability theory.

In other words, in today's physical science information is conceived as order, however not just any order but one opposite to thermodynamic entropy; information is understood as negentropy, entropy with a negative sign. Such an interpretation of information actually turns it into a standardized physical magnitude to be measured, subjected to various empirical studies; along with its precise quantification and structural modelling of the widest range of information processes. Together with this, of course, the term 'information' retains its full semiotic diversity, which alongside its objective meaning as negentropy, includes subjective knowledge and symbolic character - the information signal.

While in Part III we shall emphasize precisely on the symbolic and semantic side of information, here we'll focus on its objective reference. Therefore, after the general response, as to what information is as physical quantity, namely the opposite of entropy - negentropy, we now move on to the second question: Are there any informational processes outside and independently of human consciousness as well as whether did they ever exist before the advent not only of humans, but even that of life in the universe?

To ground the above more or less general and abstract reasoning let us refer to some specific physical interpretations of the category 'information' and what scientists refer to as 'informational' physical processes.

To begin with the first, let us look at the concept of the holographic universe, developed by Leonard Susskind, in a debate, critical but constructive, with S. Hawking. - Susskind's and other authors' thesis is that 'information' should not disappear in similarity with the principle that mass and energy should not be wasted. - These are not abstract philosophical speculations but concrete conclusions of cosmological theory - in particular relating to the 'black holes'. As known, all absorbed by the 'black hole' matter irreversibly disappears behind its visible horizon of events and is absorbed by its singularity. But does this not contradict the second law of thermodynamics, according to which the entropy of the universe is only growing, but is not to be deleted? If all of entropy absorbed by the 'black hole' objects irreversibly disappears behind its visible horizon, is it not this an example of reduction of entropy at odds with the universal laws of physics?

We shall not discuss this matter, and shall only say that Susskind and Hawking in their debate directly refer not to the thermodynamic entropy (of ingested objects, the very 'black hole' and the universe as a whole), but to their information! They say that what should not disappear is not the entropy, but the information relating to the physical system under consideration, besides basing themselves on purely thermodynamical arguments. I pointed this example just to show that for hard science information is namely a category and a magnitude of thermodynamics and informational processes themselves - thermodynamic.

In the further account we shall go back to this theoretical case, and shall enclose two more - the principle of Landauer and the experiment by Shoichi Toyabe. On one hand they are opposed, on the other they establish an important equivalence. Landauer argued that the erasure of one bit of information

inevitably leads to the release of a minimum amount of heat. Toyabe conversely shows experimentally that the introduction of one additional bit of information in a physical system leads to the increase of its energetic potential with a maximum quantity of energy theoretically predicted by Leo Szilard and Léon Brillouin.

These are really exciting experiments, pulling round the scientific community discussing them, but here we consider them with a different purpose. The aim is to see what actually Landauer and Toyabe understand by a physical informational process. What do both scientists actually change in their experimental setups; what makes them and the scientific community carefully controlling them, so convinced that their experiments are informational; that they are experiments, related to nothing else but precisely the informational aspect of the studied objects and events?

Without explicitly going into details (this will be done in the next, Part II), we shall note that in practice, from an energetic point of view, in both experiments the scientists attach quite negligible amounts of energy to a nanoparticle, but it is interesting that this nanoparticle starts to behave in a qualitatively new way, unexpected and challenging for the standard expectations of the scientific community. In particular, the experiments related to Landauer's principle register the release of heat associated with the erasure of information, and in the Toyabe experiment - an energy gain, related this time with the addition of information.

Outwardly, both experiments can be reduced to purely energetic processes and interactions. Then what is their difference from the standard energetic interactions? Why is the scientific community consensual that at their core these processes, changes and effects are informational? If one expects to find in such processes a new 'informational' substance to be registered experimentally

in pure form; which once removed is converted into heat, and next increased - produces energy, he will be disappointed. Yet the experimenters are explicit - both changes (in the amount of heat and the amount of energy) are caused by nothing other than informational processes. But what does that mean?

If we carefully follow what happens in the course of the experiments, on the surface, we shall see nothing special - just an external influence. - Just insignificant energetic impacts are applied to the spontaneous thermal fluctuations of a nanoparticle. But what is actually changed as a result of the experimental impacts? - Here we encounter something interesting - the attached external energy does not trigger a change of the energetic behaviour of the nanoparticles, but a change in the overall structure of the probability distributions of their dynamics. - Which is really not as complicated as it can be assumed from this formulation, but is a matter of a common phase transition in the dynamics of the object. For instance, such a phase transition is freezing, melting or evaporation of water. The special feature of such a phase transition however is that, subsequent to it, the probability distributions of the spontaneous thermal fluctuations of the particles in the system become completely different. And, which is not less essential, at the very point of such phase transitions, the applied external energy, or the heat released from them, is not connected with a change in the energetic behaviour of the particles, but only with the general structure or what is called the probability distribution patterns of their dynamics.

So, by informational processes we'll further understand such physical processes that are associated with the change and control of the sustainable characteristic pattern of the probabilistic distributions of the spontaneous thermal fluctuations in thermodynamic



systems. Or to get a cruder, but neater definition - information processes are aimed at changing the probability distributions of the behaviour of thermodynamic systems, not of their particular physical structure.

This in turn enables us to move forward and treat the category 'information' with regard to the nature of the mental states.

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### **Chapter 3: How does the subject extract energy and information from the outside world?**

*Synopsis:*

*Based on considerations and examples of thermodynamic and biochemical character, it is inferred that the energetic dynamics of the subject is directed against the gradient of physical nonequilibrium.*

Let me first make a proviso that the reader should have in mind when reading this chapter. I have been interested in the problem of the relationship between consciousnesses and information for decades and my view has been changing. In the beginning I tended to understand information as a kind a substance. Certainly it was not just my attitude but it was based on a whole sustainable trend of information studies, which at the end of the book is referred to as 'the romantic theory of information'. On the whole this approach tends to accept that information is a kind of 'entity', or a 'substance', much in the same way as 'matter' and 'energy' are considered to be substantial, although qualitatively completely different from them. Correspondingly, I was inclined to believe that information has an independent physical existence of its own; that it is a very specific physical object (or rather - substance) indeed, and whatever it is, it does objectively exist; that it is very closely connected with knowledge and consciousness and which under certain still unknown circumstances could somehow be converted into them.

Now my standpoint is quite the opposite and I tend to understand information in a purely negative way. That is, I believe that what does objectively exist is order, or to be even more precise - disorder, entropy - and information is just neg-entropy (Brillouin). So now I believe that information is not a 'substance', to say nothing at all that

it may be some independent physical object. Entropy is the level of disorder and information is just the measure of the reduction of disorder in dynamical systems during nonequilibrium or equilibrium phase transitions.

The thesis of this chapter was developed under the 'substantial ideologeme' of information. Although the word 'information' is scarcely mentioned in it and the basic object of consideration here is 'energy', I must recognize that at that time I did believe that we could somehow 'extract' information from the environment and on the whole handle information as a kind of 'fluid', a flow analogous to an energy flux. Still, I think the thesis remains correct provided that we properly substitute 'order' ('negentropy') for information, instead of 'substance' or 'something'.

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Sometimes it is believed that the discovery of the principle of self-organization has also led to the understanding of the behaviour of intelligent systems. This discovery is undoubtedly a significant step forward; in many cases the life dynamics of biosystems, especially at biochemical level, or the neurodynamics, the cardiodynamics and the general physiology, not only they, but even their macro-dynamics, besides not just their individual behaviour but also that of the social systems, reveal interesting projections, evidence and forms of self-organization.

But although it includes self-organization in its toolbox, the principle of intelligent behaviour is different. In fact it is the opposite of self-organization, although like it (and often even using it as a tool), it also creates order

and often one that is incomparably more efficient and beautiful.

Spontaneous self-organization arises at levels, highly remote from the equilibrium; but self-organization cannot itself give rise to nonequilibrium; it is the fruit of its dynamics, but nonequilibrium must first be caused by external factors, by an external supply of energy; it is impossible for a non-living system, to create itself the preconditions for its self-organization; this is always at the expense of external forces - random or intentional.

This brings us to an important point with regard to the behaviour of intelligent systems: the subject has a unique attitude to the energy and the informational order in the outside world:

1. The energetic dynamics of the subject is directed against the gradient of non-equilibrium.

This dynamics does not drift down the slope, but against the spontaneous inertia gradient of the physical processes. One convincing way to illustrate this is the example of the sailor, who can orient the sails so that he can move against the wind.

A look at the energetic and the informational specificity of biodynamics will also show that it is based precisely on the transmission of energy and information (negentropy) from the lower level to a higher gradient level.

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Let us, because of their crucial and universal application, refer for example to the various 'energetic pumps' that control the channels of the material communication between the cell and its external

environment. Thus, for example, the  $\text{Na}^+/\text{K}^+$  pumps in the neurons maintain levels, contrasting the natural osmotic gradient of potassium and sodium in the cell environment and its exterior, thereby creating a stable polarized state, allowing the flow of bioelectric information impulses to the cortical analyzers.

### Sodium-potassium pumps

The relatively high concentrations of potassium ions, but low concentrations of sodium ions into the cell are due to active transport. The mechanism responsible for this is the sodium-potassium pump which moves the two types of ions in opposite directions across the plasma membrane. It is already known that the carrier is the enzyme ATPase which pumps three sodium ions out of the cell for every two potassium ions introduced inside. This leads to the formation of a negative energetic potential of the cell protoplasm with respect to the positively charged extracellular environment.

#### Mechanism:

- The pump, while connecting with the ATP is associated with 3 intracellular  $\text{Na}^+$  ions. ATP is hydrolyzed, leading to phosphorylation of the pump at a highly conserved aspartate residue and subsequent release of ADP.

- The conformational change in the pump brings the  $\text{Na}^+$  ions out. The phosphorylated form of the pump has a low affinity for the  $\text{Na}^+$  ions so that they are released out of the cell membrane.

- The pump is connected with 2 extracellular  $\text{K}^+$  ions. This causes the dephosphorylation of the pump; it returns to its previous structural state, transporting in this way 2  $\text{K}^+$  ions into the cell protoplasm.

In the nonphosphorylated form, the pump has a higher affinity for the  $\text{Na}^+$  ions than for the  $\text{K}^+$  ions; so that two bound  $\text{K}^+$  ions are released. The ATP is bound and the process begins anew. (Source: <http://en.wikipedia.org/wiki/Na%2B/K%2B-ATPase>)

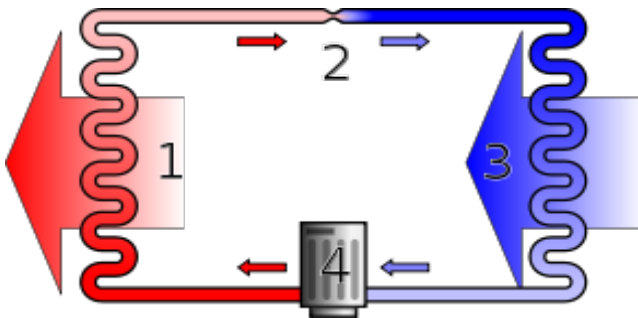
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An Intelligent subject, on account of the application of specific tools, technologies and approaches, can not only, like a sailor, move against the energetic gradient, but is able even to extract additional energy and information in a direction opposite to this natural causal gradient.

How does this work? - Only through the use of most versatile, smart, and in all cases effective means for this purpose.

We've already considered the potassium-sodium pumps, which allow maintaining an artificial electrical imbalance between the protoplasm of the cell and its external environment. But personally I like to refer to another, belonging to domestic life, example - the heat pump (known also as 'air conditioner' or 'refrigerator'):



*Fig. 4. Diagram of the cycle of operation of a heat pump: 1) capacitor, 2) expansion valve, 3) evaporator, 4) compressor.*

Heat pumps use a refrigerant fluid as an intermediate agent:

- In order to absorb heat when the agent is evaporated in the evaporator and then
- To release heat when the refrigerant is liquefied in the condenser.

(Source: [http://en.wikipedia.org/wiki/Heat\\_pump](http://en.wikipedia.org/wiki/Heat_pump))

This clever device allows us to be heated, as we extract heat from the chilly winter air; or to export heat from our premises outside in the summer swelter.

The air conditioner is designed so that the temperature in the evaporator is always lower than the ambient one (whether in or outside the room), and the temperature in the condenser is always higher than the ambient temperature. Thus, the air conditioner can always transfer heat in the opposite direction of the existing thermodynamic gradient between the external and internal environment.

The point is that there are always such natural phenomena that allow us, at the local level, to achieve an energy gradient lower or higher than that of the environment<sup>5</sup>. Once such processes have been found

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<sup>5</sup> In the living cell, such phenomena are the enzymes. 'From a biochemical viewpoint the enzymes are catalysts of chemical reactions in living cells. They have extremely complex and relief spatial form. They don't react chemically with the organic substances in the cell, but only accelerate the biochemical processes. They accomplish this because of their complex structure, which meshes in the critical points of the cellular molecules. The enzymes shape the structure of the chemical agents and achieve an inimitable acceleration of chemical reactions in the cell, which often run at a speed of one million times higher than that in the non-living nature. This widest possible range of intensity enables the realization of a maximally possible behavioural repertoire. The catalytic dynamics of the enzymes raises complex chains of conjugated autocatalytic reactions. They are the basis of the stable periodic behaviour and chaos, and the ability to self-replication

and causing them at our will and desire, through our actions (work - in the sense of physics), we are able to manage the flows of free natural energy for our own purpose and benefit. Moreover, by doing work with specific tools we can extract and create such free flows of energy, which would themselves have never occurred in this world spontaneously, by virtue of the natural causal law alone.

2. The same principle applies to the information interactions of the intelligent subject.

As to cognition, it is clearly a process directed against the natural information gradient, i.e., against the gradient of entropy; a process in which the subject that has dramatically higher information potential than its life world, is able to extract information from it.

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To achieve control of information flows, the subject is required to have the means with which to reverse their natural move towards increasing entropy or in other words - to extract information from the outside world. What we saw is that this is achievable for cellular biochemistry and even for engineering constructions. The subject, however, must achieve much more than that; it must rise to the full diversity of the semiotic triangle, as not only its valences of the sign and meaning should be satisfied, but also that of the sense. Here,

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of biological systems. The living cell is a self-replicating system of catalysts-enzymes. (Димитров, А., Елка Янкулова. 2004. Хаотична динамика на биологичните системи и комплексна гена динамика. Фабер, В. Търново)



however, we talk about information not only in its sense of order; it is about knowledge in the sense of an inner subjective state, peculiar of intelligent agents.

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## Chapter 4: What are the mental states?

### *Synopsis:*

*Mental states do not occur in and do not represent the presence and impact, but on the contrary - the absence of specific physical agents.*

*It is argued in particular, that colours do not appear in the presence of certain electromagnetic waves but in their absence. - Colours don't express the presence, but the absence of certain electromagnetic waves. For example, the black colour is the complete absence of light waves. Orange is not the colour of the wave of length of 620-590 nm; orange colour is in fact the absence of any other waves of the light spectrum, except that one of a length of 620-590 nm (and emitted at a frequency of 484 THz).*

*Similar is the relationship between the feeling of hunger and the various taste sensations; the same principle seems to be valid for other sensory modalities.*

One can discuss whether intelligent behaviour is possible unless it refers to mental images. Are intentionality and rationality possible without the mediation of concepts or mental states at the least? Something similar to this is the discussion of artificial intelligence. Whether the machine can generate rational behaviour without the use of mental 'software'; without having concepts, perceptions, feelings, emotions, etc. mental states? But whatever the answer to the question whether intelligence without mentality is possible, human intelligence and rationality are inseparable from the phenomena of mentality.

Mental states:

Mental states can be cognitive, emotional or volitional. Cognitive mental states include: sensations, perceptions, ideas, thinking, etc. Sensations in particular comprise: interoceptive (pain, hunger. etc.); proprioceptive (mainly motor and equilibrium) and exteroceptive (visual, hearing, taste, smell, tactile). Here we shall mainly refer to visual sensations - the different colours, i.e. the various colour tonalities.

The term 'colour tonality' is introduced by analogy with the sound tonality, i.e. with the sounds - the specific states of the auditory modality. We shall afford a wider use of the term 'tonality' or 'tonal state', which in some cases (they will be specifically mentioned) it will designate mental states whatever. The reasons for this will become clear at the end of this chapter.

So far, we've paused shortly on the ontological schism, the rift between the subject and the object of knowledge, the subject on the mental states in general. Now we shall continue with some other assumptions - some particular theses concerning the nature of the subject and its internal, subjective mental states, from energetic, informational and substrative perspective. Then, we'll try to assemble these foreshortenings in a more coherent picture.

About the substrate of the mental states

One of the central themes of our outstanding explorer of consciousness, Aristotel Gavrilov is that the mental image cannot have a content of its own. The image, he says, is not a picture, a portrait, but an open window through which the subject perceives the very real object itself. Indeed, if the image was a picture, it would not be revealing, but rather would be hiding the original object. Its own content would be a blind, a screen, a wall that

obscures and makes the sight of the original content inaccessible.

However, mental images do exist. How can there be something lacking a content of its own? What are mental images (mental states) made out of?

There is only one logical answer. - From *nothing*. Perhaps the futile efforts to find mental images as a correlate of brain activity are the strongest confirmation. But here we adopt a more positive approach to the nature of the tonal states as generally all the sensations are, of which, in particular, we shall refer to colours.

Nothingness, however this is unlikely, but equally obvious and common knowledge - nothingness has colour. We do not perceive the absence of any visual stimulus as 'nothing'; we all know that this total absence is perceived as black colour. The black colour is the complete absence of light waves.

We can explain the occurrence and the nature of the other colours in much the same way. The orange colour from such viewpoint is not the colour of the wave of a length of 620-590 nm; the orange colour is in fact also a 'black' colour, i.e. it is the absence of any other waves of the light spectrum, except that of a length of 620-590 nm (and emitted at a frequency of 484 THz). It is clear that the other colour tonalities can be approached in the same way.

Similar is the relationship between the feeling of hunger and the many taste sensations; the same principle seems to be valid for other sensory modalities.

How to approach the tonal states inherent in other sensory modalities? Say, the sounds? Shall we start from silence as 'an empty' tonal perception of the complete absence of audio waves? Or should we refer to the synaesthesia, which allows reducing all sounds to colours? Or, shall we look for a basic for all modalities zero tonality from which to get all of them?

## Chapter 5: How do the mental states occur?

### *Synopsis:*

*The hypothesis about the 'informational collapse' as a physical prerequisite for the generation of mental states is outlined. The possibility of such a collapse is referred to the equivalences of respectively mass and energy, and energy and information.*

The idea of this chapter was also developed from the standpoint that information is a 'substance', along with matter and energy. As mentioned, currently I do not share this view, associated with Norbert Wiener. I accept, in agreement with Shannon and Léon Brillouin that information is a value derived from probability (and through it - from uncertainty); i.e. that information is not a substance but a reduced, removed uncertainty.

The idea of the informational collapse assumes that the information is a substrate which the subject can extract from the outside world (and against the gradient of non-equilibrium); *this substrate could be accumulated and hence its super-critical accumulation leads to the occurrence of an informational collapse.* Accordingly, the idea is that after the advent of the informational collapse, the information transfers into a mental state and a new ontological entity arises that has all the qualities of the intelligent subject: ability to learn, to understand, capability for targeted actions and so on.

The question, however, is that the idea of the informational collapse entirely preserves its relevance in a purely probabilistic, i.e. non-substrate view of information to which I now adhere.

First, the very mechanism of the informational collapse is expressed in non-substrate categories and is in fact based on the theoretical equivalence of energy and information. As far as this equivalence is valid

irrespective of whether information is a substrate or not, obviously the possibility of the occurrence of the informational collapse remains under the non-substrate theory of information.

Second, the idea of the informational collapse retains its epistemological value under the non-substrate theory as well, because it seems that the informational collapse is precisely the event, leading to the opening of the window of the subject towards objective reality, i.e. to a state of informational openness of the subject towards the external objective world.

Another possibility to achieve informational openness can of course be seen in the reduction of probabilistic uncertainty of thermodynamic systems under phase transitions. But such a possibility seems a more unlikely mechanism of mental processes as far as phase transitions are a ubiquitous physical phenomenon that can hardly be distinguished from standard physical causality.

### 1. The hypothesis about the informational collapse

The informational collapse should be considered in analogy to the gravitational one. - The super-critical concentration of information should lead to an informational collapse - a condition in which information changes its physical condition - from material order, it becomes the singularity of an informational 'black hole'. This singularity continues to 'absorb' or I would rather say now to *produce* information.

On the other hand, this singularity is the reference of the 'informational nothingness' - the zero information state, which in turn is characteristic of the mental states. So, thanks to the informational collapse, information acquires mental nature; it refers not only to the object

side of the semiotic triangle, but also to its conceptual, semantic side.

## 2. The physical meaning of the informational collapse

The physical meaning of information most often refers it to order; or, to the concept of probability. And of course, both concepts intersect and overlap in the sense that the more ordered a structure is (and more organized a dynamic is), the less likely it is for it to exist. But, be as it may, we do not have such a robust definition of 'information' as we have about 'mass', i.e. about the object of the gravitational collapse. Therefore, it is difficult to imagine the physical conditions under which an informational collapse could occur. Not to mention about its experimental verification.

Therefore, we shall follow a circumlocutory approach:

- We have the theoretical relationship between mass and energy:  $E = MC^2$
- If we find a theoretical relationship between energy and information, this brings us to the mass equivalent of information. - Which is nothing else but the searched condition in the presence of which it is expected that an informational collapse should occur.

Such a link does exist. Other solutions may be possible, but the familiar to me is the one, already mentioned, based on the Szilárd ratio of the equivalence of energy and information, described in:

<http://physicsworld.com/cws/article/news/2010/nov/19/information-converted-to-energy>

“Szilárd formulated an equivalence between energy and information, calculating that  $kT \ln 2$  (or about  $0.69 kT$ ) is both the minimum amount of work needed

to store one bit of binary information and the maximum that is liberated when this bit is erased, where  $k$  is Boltzmann's constant and  $T$  is the temperature of the storage medium.”<sup>6</sup>

Now we can go on the reverse way, i.e.:

- First, calculate the energetic equivalent of the gravitational mass at which a gravitational collapse takes place<sup>7</sup>; i.e.,  $E_{\text{collapse}} = 2M_{\text{Sun}} C^2$
- Next, calculate the informational equivalent of the above energy;  $I_{\text{collapse}} = E_{\text{collapse}} / kT \ln 2$  (bits)
- As a result we obtain the amount of information in bits, which is equivalent to the mass at which a gravitational collapse occurs;  $I_{\text{collapse}} = E_{\text{collapse}} / kT \ln 2$  (bits)
- Then, we can look for empirical systems with a similar concentration of information potential and to observe their behaviour;
- The next step is to artificially produce similar systems.
- So,

$$I_{\text{collapse}} = E_{\text{collapse}} / kT \ln 2 = 2M_{\text{Sun}} C^2 / kT \ln 2 \text{ (bits)}$$

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<sup>6</sup> In more detail, the question of the equivalence of energy and information will be discussed in Part II, Chapter 1 (The computational Ideologeme).

<sup>7</sup> The amount of that mass is approximately equal to two solar masses ( $2M_{\text{Sun}}$ ). – “According to Einstein's theory, for even larger stars, above the Landau-Oppenheimer-Volkoff limit, also known as the Tolman-Oppenheimer-Volkoff limit (roughly double the mass of our Sun) no known form of cold matter can provide the force needed to oppose gravity in a new dynamical equilibrium. Hence, the collapse continues with nothing to stop it.” ([https://en.wikipedia.org/wiki/Gravitational\\_collapse](https://en.wikipedia.org/wiki/Gravitational_collapse))



## Chapter 6: What are the data?

Curiously, the same thing that occurs with money happens to information. Money, as we know from political economy is a later product of exchange relations. Along with natural products, a new product began to attend the exchange. Money itself possesses no natural use-value. At a certain stage a brand new semiotic construct was included in the exchange of natural products.

Initially, the function of money is purely technical and the goal is to facilitate the exchange. It is something completely different from the actual use-value, subject to stock exchange, and in relation to these natural products it is nothing more than an additional external label or accessory sewn on them. Money is simply a character that should mark the actual presence of a natural product; an external tool applied to exchange.

But by the time that sign changes its semiotic status and is reified, i.e. converted into meaning (reference, denotat). And it happens so that money, from an external label sewn to the goods, itself becomes a real product or more precisely acquires exactly the same ontological status in the system of market economy. Further, it ascends more and more rapidly and uncontrollably, and today in more and more diverse and bizarre mutant forms, it dominates the heights of social hierarchy.

But these are things described in a far more accurate, specific and justified manner in Marx' political economy, and as for today's evolution of money it is worth reading the short but very meaningful study by Alexander Gungov in the collective monograph "Ontology of Virtual Realities." Our problem is information and, as already mentioned, it undergoes a disturbingly similar in character evolution in today's information society.

'Pure' information exists as data. Data are nothing but signs, i.e. complex material structures, in which information is encoded. But data are not information. The information is externally attributed, assigned to data as money itself has no natural use-value and only is a convenient sign substrate.

Any material structure can be a database; just some material structures are technically more suitable for this purpose than others - because of their durability, compactness, portability, calculation mode of operation etc., etc. But, to repeat - data is not information, but its sign and to put it more generally - they are a particularly effective tool in the creation, transmission, reception, processing and storage of information.

In itself, information exists objectively as negentropy, i.e. removed probabilistic uncertainty. As well as subjectively - as a mental state, knowledge, and sense. To date, however, by analogy with the cash flows, the data, the data bases as well as the operations of their generation, transmission, processing and so on acquire the status of information objects. In fact, it is these arrays and data streams what are most often understand as information and information processes today.

The aim of this brief reminder is not a social or theoretical critique of the information society. It is an attempt at a short explication of its three main semiotic pillars: its symbolic structures (information data), its objective meanings (references - negentropy, i.e. the reducing of the probability uncertainty of systems' dynamics) and their subjective image (knowledge, concepts, and meanings). As to the particular dynamics and future perspectives of the information society, the shapes of its self-organization and control will become still more complex and will expect a truly befitting and deserving theoretical analysis.

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## Chapter 7: A concise model

It goes as follows:

1. What is information?

Information is reduction of entropy.

2. What is consciousness?

Consciousness is a state of informational openness of the subject to the objective reality.

3. When is a state of informational openness achieved?

It is achieved at very high levels of reduction of its entropy.

4. How high are these levels of reduction of entropy?

Very high. In all likelihood this ontological breakthrough comes about at reduction levels that are informationally and energetically equivalent to the mass in which a gravitational collapse occurs.

Therefore, the event in which informational openness occurs, i.e. the window of the subject to the objective reality opens, we call 'informational collapse.'

For convenience of the reader, the tentative calculation of the quantitative aspects of the informational collapse is reproduced below:

- First, we calculate the energetic equivalent of the gravitational mass at which a gravitational collapse takes place; i.e.,  $E_{\text{collapse}} = 2M_{\text{Sun}} C^2$

- Next, calculate the informational equivalent of the above energy;  $I_{\text{collapse}} = E_{\text{collapse}} / kT \ln 2$  (bits)
- As a result we obtain the amount of information in bits, which is equivalent to the mass at which a gravitational collapse occurs;  $I_{\text{collapse}} = E_{\text{collapse}} / kT \ln 2$  (bits)
- Then, we can look for empirical systems with a similar concentration of information potential and to observe their behaviour;
- The next step is to artificially produce similar systems.
- So,

$$I_{\text{collapse}} = E_{\text{collapse}} / kT \ln 2 = \\ = 2M_{\text{Sun}} C^2 / kT \ln 2 \text{ (bits)}$$

5. What is the likely physical mechanism of the informational collapse?

As it became clear, such an event requires a massive reduction of entropy. Probably, the main task of the human brain is:

- First, to generate colossal entropy in the dynamic system of the communication of the tens of billions of neurons;
- Secondly, to reduce this entropy close to zero.

These two events as a whole are equivalent to the necessary gain of information, which is a prerequisite for an 'informational collapse', i.e. the event in which the subject receives an informational access, openness to objective reality.

From this point of view, the principle of the information machine (the technology of absorption of information - in fact of entropy!) of the subject does resemble that of the heat pump. - I.e., along the channels of the sensory

communication, a data stream with very high entropy flows from reality to the the subject, that is sharply cooled (reduced) on the above thermodynamic principle. This leads to the acquisition of a huge amount of information as regards objective reality by the epistemological subject.

The informational collapse is a physical mechanism underlying mental states. - Mental states, as it was shown (e.g. about colours) are states that are completely empty of any physical or informational content whatsoever. Consequently, the function of the informational collapse is to generate a state of complete informational emptiness much in the same way that the gravitational collapse creates a physical singularity, devoid of any physical content that the principles and laws of physics can explain and handle. Mental states require a complete informational nothingness (emptiness) and this is a state that only a presumable informational collapse could produce. As to the possible informational preconditions and the scenario leading to such an informational collapse, they were partly discussed above and certainly remain as topic of subsequent and further discussions.

Another mechanism is also possible assuming that information is a physical substance, alike matter and energy. If, from this point of view we assume that information, conscious or not, is an objective substrate, an informational collapse should occur in an information machine (computer), provided that a super-critical amount of information necessary for the occurrence of an informational collapse is introduced into its active memory.

In fact, in that same moment it can be assumed that a fantastic event has happened - the information machine

has acquired the ability to be aware. And we can precisely calculate at what amount of bits stored in its active memory this fantastic event is supposed to take place.

## PART II: NEUROSCIENCE AND CONSCIOUSNESS: THEORETICAL MODELS

Synopsis:

*The neuroscience of today is dominated by two main models of the nature and function of consciousness: the holonomic and the computational one.*

### Chapter 1: Holonomic ideologeme<sup>8</sup>

Not only in science but also in today's enlightened mass consciousness, mainly two models of consciousness, the holographic and the computational are most popular. We shall consider both. We begin with the holographic model. It starts from many assumptions and poses many problems; it leads to a variety of answers, draws different perspectives, on which we cannot and need not to stop here. The main thing that interests us is its account on the nature of the mental images. - It is that mental images are holograms. In fact the whole world in which we live, the whole universe is a giant hologram, projected on the periphery of a cosmological 'black hole'. In any case, the general solution to the problem of consciousness and in particular - mental images is that they are a holographic projection of a quantum field of possible states, which is accomplished by our brain.

Many questions arise here. - What is the substantial nature of the primary quantum probability field? A very

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<sup>8</sup> The text has been prepared also in consideration of presentations:

[https://www.youtube.com/watch?v=IMBt\\_yfGKpU](https://www.youtube.com/watch?v=IMBt_yfGKpU),

<https://www.youtube.com/watch?v=2DII3Hfh9tY>,

[http://ademyakup.blogspot.com/2011/08/blog-post\\_16.html](http://ademyakup.blogspot.com/2011/08/blog-post_16.html) .



vague answer is that it is informational. What is the projector itself - the brain - is it a part of the primordial quantum field or is it also a holographic image? If the world, we see, is nothing else but a holographic image, then who is the one that sees? If this is the 'soul' or the mind, then what's the point of the whole holographic ideologeme that should explain just that - the nature of mental images and that of mind?

There are two disturbing tendencies in modern science and academic philosophy. - Philosophy is not particularly interested in the revolutionary changes in the scientific picture of the world; even enlightened mass consciousness seems to be much more involved with it. The reason for this seems to be the role of modern technologies, which penetrated into the everyday life of the people; another reason are the electronic media, which are not in need of the royal sanction of academic philosophy so as to bring the really impressive breakthroughs in modern technology, besides in a very accessible form, into the worldview picture of the common user of information.

Another disturbing fact is that the ideological popularizers of the modern scientific picture, and unfortunately scientists themselves sometimes show unenviable philosophical incompetence. Seeking for answers to questions that philosophy is not able to resolve, they formulate these questions in a very naive way; their responses accordingly lose their value and relevance; these responses would lose their value even for those who pose them, if only they rethink them a little more carefully and critically.

It seems the most attractive point in the holographic ideologeme for those who defend it, is that the hologram is a 'disembodied' optical image; that, according to them, the hologram in the same way as mental image is not located anywhere. This claim is unfounded. Ultimately

the holographic image falls exactly where fall and are located all optical images, regardless of their physical medium, namely - on the eyes' retina. As for the actual physical substrate - the carrier of the holographic information, here things are not sensational, either. The primary carrier is the holographic photo plaque; that on their path to the retina, the optical beams projected from the photo plaque pass in a very complex and specific route is also not a phenomenon without precedent, compared even to the route of a beam of light refracted through a simple optical lens.

As mentioned, there is another reason for the persistence of the holographic model. It is its connection with modern information technology and especially its replication in the environment of the mass media. That replication, circulation and one would even say universality, is probably the reason for the strength of the impact of this model on, scientific and, if so to speak - mass culture technological consciousness.

At any rate, my goal by far is not to debunk holographic ontology of consciousness. There are many interesting assumptions, theses, arguments and even original conclusions of what many of my esteemed colleagues would call metaphysical nature.

The most interesting thing for me here is what led to the formulation of the holographic ideological view of the world and consciousness; what are its specific, original, meaningful and above all ideologically attractive premises?

1. Solid matter, for the umpteenth time in a row, is falling apart before our eyes

*Synopsis:*

*It turns out that reality is not made out of solid state structures but rather out of objective probabilistic states. The deep substantial matrix of objective reality is probabilistic. It is not solid physical structures and interactions between them that underlie physical reality, but rather - objective probability states and superpositions among them. The structures of our sensory and practical experience are a product of the collapse of probability functions as a result of physical measurement and perhaps even of a sensory observation.*

Holonomic ideologeme paid particular attention to a most important and equally old, experiment in quantum mechanics - 'the double slit experiment'<sup>9</sup>.

The purpose of this experiment was to determine whether the electron is a wave or a particle. For this purpose it had to pass through two holes of a dense membrane, backed by a photographic plate. Clearly, if the electron is a particle the imprint on the plate must be two vertical bands corresponding to the two openings of the membrane. In the case that the electron is a wave, however, a different picture consisting of a greater number of vertical, parallel to the two openings, stripes

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<sup>9</sup>“Clauss Jönsson’s double-slit experiment with electrons. (1961) The double-slit experiment is a demonstration that light and matter can display characteristics of both classically defined waves and particles; moreover, it displays the fundamentally probabilistic nature of quantum mechanical phenomena. This experiment is sometimes referred to as Young's experiment.” ([https://en.wikipedia.org/wiki/Double-slit\\_experiment](https://en.wikipedia.org/wiki/Double-slit_experiment))

should be observed on the plate. The reason is the interference of electrons-waves that passed through the holes.

The first results were not worrisome. Interference pattern, consisting of many parallel vertical stripes was observed, which should mean that the electron behaves like a wave. - More precisely - the electrons - because the plate was originally bombarded not with a single electron, but by a beam of electrons. Later it became possible to emit not a bundle, not many, but even a single electron. And even in this case, although as a single pulse, the electron typified the interference pattern on the plate, which could mean one thing - it is able to pass through both slits simultaneously and interfere with itself; i.e. it was a clear confirmation of its wave nature.

But the researchers wanted to see if indeed a single electron can pass simultaneously through two holes and for the purpose put detectors at both of them. The result was so astounding that the comments have not been completed even today. If the passage of the electron was 'observed', or it is more correct to say registered, measured by a detector, the electron behaved like a corpuscle and left on the plate only such traces as say a bullet leaves behind while shelling a paper target. The picture was completely in line with the hypothesis about the effect of bombardment with an electron particle, not an electron wave.

But all this happened in the early 60s of XX-th century; why does the holographic ideologeme of today resurrect the spirit of a particularly bright and exciting, but bygone historical era? - Today this experiment is held and modified in an ever more sophisticated manner, however not in the quest for scientific data and facts, but rather in order to achieve some frankly ideological effects. The main one is to show that it is not so much the physical registration, measurement of the state of the

electron by the detector, but it's very human observation that causes the physical collapse of the wave into a corpuscular structure.

For this purpose, even known authors such as T. Campbell state: even if the detectors on the slits have been switched on and they did record, if data records are deleted we shall again have interference, not corpuscular picture of the experiment. It's really to say too much; even to people like me who are unfamiliar with quantum mechanics. Indeed, there have been other experiments whose essence is to mark the emitted electrons, and when the electrons pass the slits, the marks are to be deleted. These experiments give a wave picture of the distributions on the plate and are recognized to be correct. Experts say that the difference between Campbell's theory and the experiments with marked electrons is that the registration of the detector is an irreversible, while marking - a reversible process.

"Physicist Thomas Campbell makes the following claim if you leave the detectors turned on, but you throw away the data from the detectors without looking at it, you get a wave interference pattern on the screen behind the slits. Is this true? No. Once the data is detected by an irreversible process, deleting the data does not induce any changes. It does not matter whether you throw away the data or look at it. The only thing you can erase are reversible markers. For example you can make the paths in the double slit experiment distinguishable by using polarizers at each slit. Afterwards it is possible to change this polarization without destroying the photon, so you can shift the polarization of the beams originating from both slits such, that they are the same again. As no irreversible process happened, the interference pattern will reappear. In this case you could get which-way information and destroy the interference pattern if you measured the photon at the right position and time, but as you never measure, it persists. This is very different

from actually measuring and throwing away the data, which will never give a persisting interference pattern.”

Source:

<https://www.physicsforums.com/threads/double-slit-experiment-with-detectors-not-recording.414617/>

I do not dare to go into thinner details. With or without them, the ontological thesis of the holonomic ideologeme seems to be definite enough: reality in itself is a quantum superposition of all its possible states. - If we liken the space occupied by the electron cloud with an empty room, this will be an extremely harsh and distorted but clear image of that quantum-mechanical superposition. However, when the electron cloud or reality in general is the object of observation, it collapses into discrete structures, such as the electron or the familiar everyday objects.

Ultimately, the holonomic ideologeme regards reality, as an actual but rather not material and even not energetic but as an information structure, as information. It is this information that is encoded in a holographic matrix, and this information that is projected by our brain and is perceived by our senses as a holographic image. In fact holonomic ideologeme in a bizarre fashion intertwines most advanced ideas of modern cosmology with archaic eastern, mostly Hindu and Buddhist mystical dogmas of reality as 'Maya', as an illusion. While mysticism is set say in the 'disappearing' stoutness of matter in the direction of our movement to the micro-world, as well as in the over-exaggerated role of the supervising intelligent subject that alone with his eyes and intentionality, is capable of such overwhelming transformations of the fundamental structure of the universe, advanced science is elsewhere. It rests on the ever more imperative role that information began to play as a cosmological factor.

For example, recently in the theory of 'black holes' was announced the result that all the information about the objects ingested by the 'black hole' is encoded and stored on the periphery of this 'black hole'. Hence, the already aforementioned thesis, defended in most serious scientific circles, that the universe observed by us is actually nothing else but a holographic projection of the information about it, stored on the periphery of a 'black hole' that had once swallowed it.

2. The world is not before, but into our brain.

If Berkeley, back in the 18<sup>th</sup> century (1709, 1710, 1713) attained an overpowering logical refutation of the idea of objective reality, then even today, despite of its unmatched simplicity and imagery, it is deeply alien to the philosophically unsophisticated mass consciousness. Nobody today wants to believe that the apple is a collection of sensations on the grounds that we have an access only to them, to the sensations, and not to any real and substantial qualities and structures. Don't we see that the apple is not some spooky feeling; that it stands in the objective world in front of us; that it is hard and corporeal; that besides that it is red, sweet and juicy, and a delicious food that can satiate our hunger, the apple gives us a fresh burst of energy? And let Berkeley and the philosophers think and say whatever they want.

Holographic ideologeme however seems to be on the track to reach one though seemingly very naive, but on the other hand much closer to the categories and images of everyday consciousness, and therefore much more effective refutation of the idea of 'the world in front of us', of objective reality.

Turkey, as per my university memories, has never boasted of brilliant philosophers. But things are never too late to change. Adem Yakup (Adnan Oktar) is not a philosopher in the academic sense, rather he is a pro-

Islamic ideologist-creationist, author of, say - parascientific and theosophical bestsellers, whose star, as it is right as per astronomical postulates rose from the East.

Let before us be a colourful songbird. Our idea formed by neuroscience is that the photons reflected from the bird reach our eye retina. There they are registered by our visual receptors that generate a stream of electrons, which along the neural pathways heads to the cortical vision centre located in the occipital part of the cortex. Similarly, the sound waves caused by the bird's song, are registered by the auditory receptors that generate a flow of electrons directed to the auditory cortical centre. There is no darker and quieter site than these cortical centres, yet our bright, colourful or loudly voiced visual or auditory images are to be found precisely in them.

The same applies to the perception of space. The stars we perceive as remote at millions of light years away are perceptions in reality present in the confined space of about a few cubic centimetres in the occipital part of our brain.

The colourful songbird is not located before our eyes but in our brains. We are not in the room where we write or read this; on the contrary the room is inside us. Let us not forget that not only our body but also our very brain is a physical object, and therefore it is also in the centre of our visual perception.

Let's imagine that the human brain can be isolated and placed in a tank of chemical solution supporting it. Let us now with artificial sensors (cameras, microphones, etc.) record a working environment, for example a business office. Let's now digitize these data and as a flow of electrons forward them to the corresponding cortical centres of the brain. - Then the brain, possibly located in a closed plastic box, will



perceive itself as a businessman involved and managing stunning stock market or bank speculations.

There is neither a businessman nor transactions; no colourful songbird, no business office, not even a brain, enclosed in a plastic box. There are not even atoms and elementary particles. There is no world before our eyes, there is no objective reality. There is only one continuous probabilistic quantum field as the superposition of countless possible states.

Apparently, someone has created the hologram and installed it into our brain; the brain projects it to us as 'the world in front of us'; it only remains for us to accept this hologram and interpret it in a manner consistent with our ideas, feelings, motives or values. And to respond with our actions of the challenges this hologram casts at us.

Clearly, holographic ideologeme is vulnerable to professional philosophical criticism. There is a lot of controversy - e.g. vicious logic circles, which use different subject categories as a tool to be refuted themselves. It introduces unjustified assumptions, which are not different from the mystics or myth-creativity - eg. about 'someone' or 'something' that creates a hologram and installs it in the brain.

Holonomic ideologists do not trouble to argue that a hologram is 'the world outside us', and the brain itself - i.e. a hologram creates for us another hologram that is projected by a third hologram. But who perceives the screening - perhaps a fourth hologram - our mental I? - No, the one to perceive is the human soul. But what is our soul - what was the point to construct a whole new holographic universe, besides with the purpose to explain what awareness and consciousness are, what the very soul itself is, if finally to this whole new universe it is necessary to add the soul whose explanation we are actually searching for?

We see that the power of holographic ideologeme is not in the details. Its strength is primarily in some bright theses resting on solid scientific theories and data, and as mentioned - its universal support by the new, unique technological, communication, informational and cultural environment, which is generally referred to as 'virtual reality'. Good or bad, but persistent in consolidating itself in the structures of mass enlightened consciousness, this ideologeme, in its coarse grain structure states:

- The world outside us is a quantum wave function;
- Our consciousness collapses this wave function in the known discrete objectiveness.

The same thing, in other words sounds like this:

- The world outside us is a hologram;
- Our brain projects this hologram in the form of the world before our eyes;
- Our consciousness perceives, experiences, interprets and reacts actively to the the message contained in the hologram.

### 3. How to shoot a hologram?

A laser bundle is split into two beams. One beam is reflected from shot object and falls on the photo plate. The other beam is refracted through a system of mirrors, so as to finally get on the same point on the photo plate. So it is proceeded point by point until the entire object is shot. An observer doesn't see any clear image on the photo plate, but a blurry, chaotic set of points. When the hologram on the plate is illuminated at the proper angle, a three-dimensional image of the shot object can be seen clearly. This image may be circumvented to see all the details on the shot object that otherwise cannot be seen in a simple, two-dimensional photography. Even, if the hologram is made not with light but with X-rays, the object being taken can be examined from the inside.

Holographic technology has advanced so far that the holographic images are virtually indistinguishable from the original visual objects. Unless, of course, the person to communicate with the hologram may not think of going through his interlocutor that still should not be quite a normal attitude anyway.

Going back to the two-slit experiment, we will notice that the shooting of a hologram resembles this very strange event in which electrons are torn and seem to pass through both slits simultaneously. Then again, when registered on the photo plaque they gave an interference pattern.

In fact, in the shooting of a hologram, namely the diffraction of interfering with each other light waves what is observed on a photo plate.

But what happens when the holographic photo plaque is lit at the accurate angle? - The same thing that happens with the electrons in the event that their passage through the slits is 'lit', i.e. observed, registered, measured.

In the same manner as the illuminated or observed photon essentially changes its shape and from a wave is converted into a corpuscle, the holographic image from a two-dimensional diffraction pattern wave is converted into a discrete three-dimensional object. Probably this is the reason for the supporters of holonomic ideologeme to argue simultaneously that 'reality is nothing else besides quantum wave function' and that 'reality is nothing more than a hologram.' Indeed, in its two-dimensional mode, the hologram is an optical image of such a wave function. And a collapsed wave function has the same discreet three-dimensional image as a lit hologram.

Holographic ideologeme is promoted not only by arguments of quantum mechanics and quantum optics, but also those of cosmology and information theory. The

thesis, as already mentioned, is that the three-dimensional universe we observe is actually an optical illusion, behind which stands only a screening, a recorded in holographic format information about it on the periphery of the 'black hole' that had swallowed it long ago.

This is the scenario behind which besides unscrewed fancy stand serious scientific arguments. These arguments start from the premise that information, like energy and matter is indestructible. In such a case, in cosmology, the gravitational collapse leads to an information paradox. The information about the objects swallowed by the 'black hole' not only remains behind its luminous horizon, but with time it should disappear as far as the black hole itself radiates, i.e. it evaporates.

Here again advanced theoretical ideas are mixed with unprofessional ontological culture. Scientists work guided by everyday object intuitions, while they perform complex mathematical calculations over strict empirical data. The results, when they want to represent them not only in the form of equations and theoretical models, but also to a wide audience, need to be reformulated in natural language. However, I'll do attempt to follow a little more throughout this unimaginably complicated and at times misleading argumentation.

What is information from the standpoint of 'holographic' cosmology? Surprisingly, the answer is simple and intuitively acceptable. Information is nothing but distinctions, differences between objects. But on what basis it can be argued that information, like matter and energy is eternal and indestructible? I could not find a sufficiently accessible concrete answer from the proponents of this idea, so I shall rather try to reconstruct it on the basis of theses and arguments of theirs.

One answer, of course, is that it is a *principle*. Principles are applied and not argued. Clearly, in our

time, the era of information society, information should be attributed the same fundamental nature that matter and energy enjoyed in past epochs, and certainly today. Not to mention that after the works of Shannon and Wiener, this attitude towards information has gained a rigorous theoretical formulation.

But if we look at the details of let us call it a cosmological, quantum, or holographic information theory we shall see other, perhaps even more powerful and original arguments. Who from this point of view is the carrier of the information about the holographic universe? That, as we are told is the surface of the 'black hole'. The argument is that a 'black hole' can contain as much information as can be recorded on its surface. The rationale for this I willingly submit to the authors of this thesis - for example Jacob Bekenstein and Leonard Susskind<sup>10</sup>.

But I would venture to speculate over the minimum area on which one bit of information can be written down - the Plank area - a truly unattainable small surface, even compared with the size of elementary particles. - Perhaps, the recording on such a surface is truly

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<sup>10</sup> In 1971, Stephen Hawking showed that the total area of the event horizon of a random group of classical black holes can not decrease. This sounds very similar to the second law of thermodynamics, as the former area plays the role of entropy. Even earlier Jacob Bekenstein assumed that the entropy of a black hole is proportional to the surface area of its event horizon. In 1974, Hawking applied quantum field theory to semi-classical curved space-time and found that black holes can emit thermal radiation, known as Hawking radiation. This enabled him to calculate the entropy of the black hole, which really is proportional to its surface area, confirming the hypothesis of Bekenstein. (source Wikipedia [http://bg.wikipedia.org/wiki/%D0%A7%D0%B5%D1%80%D0%BD%D0%B0\\_%D0%B4%D1%83%D0%BF%D0%BA%D0%B](http://bg.wikipedia.org/wiki/%D0%A7%D0%B5%D1%80%D0%BD%D0%B0_%D0%B4%D1%83%D0%BF%D0%BA%D0%B))

indestructible? Perhaps, in such scale quantum laws of classical thermodynamics actually cease to be valid and the information stored on such nano-carriers becomes truly eternal and indestructible? Perhaps we'll also find here an answer to the question of what happens with the information about the ingested into the 'black hole' of the past time: objects, structures, states, properties and qualities?

#### 4. Bohm and Pribram

Karl Pribram is an American neuropsychologist. He established a curious fact: in operations of lobotomy of rats, whatever part of their brain was to be cut, they retained their capacity to complete sensory and motor activity. This was true mystique for Pribram until he met physicist David Bohm, who was interested in the application of the holographic model with a very different purpose - the solution of problems of modern physics. The answer to Pribram's problem proved to be that such information is distributed on the cortex on a holographic pattern. It is known that whatever part of the hologram is to be cut, the projection displays the complete image of the photographed object.

A cardinal contribution to the establishment of holonomic ideologeme (in mass, but also in scientific consciousness) belongs to the American author Michael Talbot (1953-1992).

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Some open questions:

The 'holographic Universe' is an attractive concept, but it is silent on the essentials: how do we perceive the things, incl. the holograms? - Because the hologram may be not a solid physical body, but it isn't a perception

either. It is a, though interesting from a physical viewpoint, phenomenon, but it certainly does not replace the subjective perception.

If the holographic model is correct, then why natural objects are physical (corporeal), and are not disembodied holograms?

It is true that there aren't photons in the visual brain centre. But why is it believed that only photons are associated with a sense of colour, rather than say the electrons?

So much for the holonomic ideologeme.

## Chapter 2: Computational ideologeme

### *Introductory note:*

The reader, with interest and pleasure, will get acquainted with the innovative research of Alexander Lazarov on 'The digital world - construction and reality' (Lazarov, 2015), which for me was a source of information, research challenges and an example of what a philosopher should devote his strength and talent to nowadays.

Lazarov constructs a steady social and cultural platform - that of information society, its: ideological, ontological, social, scientific, technological and theoretical framework that finds its authentic and effective expression in the electronic communication and the digital reality of today.

Looking from this perspective, the very nature of the universe and that of human society is arranged so that the vector of their evolution necessarily points to the Digital reality. In view of the ontological prerequisites Lazarov focuses on the binary structure as a fundamental principle of ontic organization of physical reality (from the moment of the Big Bang on).

In view of the civilizational and the cultural prerequisites, there stand out:

- social communication as a form of information exchange and the resulting strategic social interest in information as a phenomenon; in the logical and technical operations and procedures, as well as in the revolutionary development of technological tools for retrieving, storage, processing, transmission and interpretation of incomparably powerful and diverse stream of binary data in the socium;

- symbolic representation as a unique aspect of intelligent communication, leading to the establishment of the information communication as a specific social



sphere, which in the form of virtual reality increasingly dominates the other social domains of today.

Lazarov departs from the Big Bang, which as Data explosion should rightly be called Bit Bang, and goes ahead to the wonders of modern digital technology. He does not seek a speculative connection and logic between the qualitative transitions in this alternative digital picture of reality and its evolution, and finds out the link in the actual, basic ontic structures (data bits), the symbolic nature of human communication, the main philosophical and scientific theories and the actual events in human history and the history of technology that have led to the triumph of digital reality and have outlined new horizons for the future of the intelligent agents.

Lazarov's theses are solidly grounded and presented in a lively and fascinating philosophical language and style, and his research is already an event not only in our philosophical literature.

This short presentation allows me to look, now from the perspective of an external observer, and trace my own approach:

1) Now it seems fragmented, one-sided and what is worse speculative in view of the real picture and the mainstream of the digital age. And also with an expired date as far as my approach does not account for the developments imposed by quantum information theory and information nanotechnologies;

2) In this work information is understood as a process, as a dynamic, not as a substrate (though fundamentally different from matter or energy) and not as a structure. Accordingly, the basis of information processes here are not binary structures (as in Seth Lloyd) but probabilities (as in Shannon and Brillouin). Information processes themselves and their effects here are displayed based

on the transition to different levels of probability distributions of a system's dynamics.

The probabilistic model of information starts from Shannon's mathematical theory of communication; Léon Brillouin subsequently built over it a physical theory of information, some of whose exciting results are to be discussed in this chapter yet. - I find the probabilistic model of information processes to be still productive and heuristic. It should be noted that: first the very binary structures Lloyd applies are actually quantum probability functions and, second, that Shannon's and Brillouin's theories are dating respectively from the 50s and the 60s of 20<sup>th</sup> c.; while Seth Lloyd, the creator of the engineering model of the quantum computer, is working in the paradigm of advanced quantum information theory<sup>11</sup> and there, as expected, the best is yet to come.

I should also emphasize Radnyo Dzanev's original theory of the physical vacuum, in particular - the introducing of imaginary components in it not only puts forward a credible alternative to the classical relativistic effects, but also gives an important place to information processes in such a complex reality.<sup>12</sup> Dzanev's theory sets the scientific ontological framework of the conception of the mental image as a detachment from the real dimensions of causal reality through transition to imaginary physical coordinates and dimensions. Hence - the cognitive image is devoid of any real physical substrate and the connection of the subject with the

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<sup>11</sup> Lloyd, S., Programming the Universe: A Quantum Computer Scientist Takes On the Cosmos, Knopf, March 14, 2006, 240 p., ISBN 1-4000-4092-2

<sup>12</sup> The momograph is also published: on [https://drive.google.com/folderview?id=0B\\_jyRrH-IBrSflhNV05nY0dRMFNCZVFHYTRLRE1MOUxTV2pBNkdITDhHNWVYYzg0d25xb2c&usp=sharing](https://drive.google.com/folderview?id=0B_jyRrH-IBrSflhNV05nY0dRMFNCZVFHYTRLRE1MOUxTV2pBNkdITDhHNWVYYzg0d25xb2c&usp=sharing)

world is only informational, in which, as through an open window the world of objective reality reveals itself in front of the subject.

I will also note the systematic, thorough and conducted in an environment of active international communication, interest and recognition Vasil Penchev's research in quantum information theory and quantum computation<sup>13</sup>.

3) I would define my own approach as 'mentalist', i.e. oriented not so much to artificial intelligence and technology as to natural (biological and human) intelligence. This approach is strongly influenced by the studies of Aristotel Gavrilov on consciousness and in particular his conception about the epistemological image. An additional accent, in the same direction, as we shall see, was imported by semiotics.

This will be true in the presentation of computational ideologeme. So even here, when we talk about computations, or data processing in general, we shall look mostly for an answer to the question whether and how consciousness itself, the state of mental awareness can cope with the role and function of an 'information processor'.

#### Background: Hobbs

'Computational ideologeme' apparently refers to the use of computers to achieve the stated objective. But the origin of the ideologeme dates back long before the advent of computers. The original version was referred to as 'calculational' ideologeme. This ideologeme is most often associated with the name of Leibniz. To Leibniz belongs the strategic idea to create a formal apparatus

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<sup>13</sup> A detailed information of the studies of the author can be obtained on: <http://www.slideshare.net/vasil7penchev/ss-15275499>

for calculation of mental operations in a manner identical with mathematical calculations. But when it comes to a philosophical exposé of the calculation ideologeme, Leibniz himself preferred to give the word to Thomas Hobbes and here we shall confidently follow his choice.

The calculational approach to the nature of thinking is outlined by Hobbes, in a remarkably clear and compelling way, in his 'Leviathan'. Hobbes' thesis underwent a long and fruitful evolution to pass through the propositional calculus and be crowned with the triumph of computer science and digital technology of today.

What is reasoning? Here is the original statement of Thomas Hobbes (1588 - 1679), developed in his 'Leviathan' (1651):

*"When man reasoneth, he does nothing else but conceive a sum total, from addition of parcels; or conceive a remainder, from subtraction of one sum from another. which, if it be done by words, is conceiving of the consequence of the names of all the parts, to the name of the whole; or from the names of the whole and one part, to the name of the other part. And though in some things, as in numbers, besides adding and subtracting, men name other operations, as multiplying and dividing; yet they are the same: for multiplication is but adding together of things equal; and division, but subtracting of one thing, as often as we can. These operations are not incident to numbers only, but to all manner of things that can be added together, and taken one out of another. For as arithmeticians teach to add and subtract in numbers, so the geometers teach the same in lines, figures (solid and superficial), angles, proportions, times, degrees of swiftness, force, power, and the like; the logicians teach the same in consequences of words, adding together two names to make an affirmation, and two affirmations to make a syllogism, and many*

syllogisms to make a demonstration; and from the sum, or conclusion of a syllogism, they subtract one proposition to find the other. Writers of politics add together pactions to find men's duties; and lawyers, laws and facts to find what is right and wrong in the actions of private men. *In sum, in what matter soever there is place for addition and subtraction, there also is place for reason; and where these have no place, there reason has nothing at all to do.*"

Leviathan, by Thomas Hobbes. Chapter V Of Reason and Science  
<https://ebooks.adelaide.edu.au/h/hobbes/thomas/h68l/c hapter5.html>

Too much time has passed since the rise of the fundamental thesis of Hobbes about the calculational nature of thinking; it has been further elaborated by its philosophical proponents; propositional calculus appeared that formulates far more specific and strict prerequisites and operations. But we shall not discuss the precision and the remarkable evolution of Hobbes' thesis; we assume that (despite the obvious limitations) it is essentially a very successful epistemological and methodological model (e.g. in computer science and digital technology); a model, which is gaining yet novel and bold dimensions:

Thus, in search of such novel, cutting-edge solutions computer scientists seriously consider to develop the trend of biocomputation - computers whose processors have biological nature - e.g. DNA computers.

In the early '90 of the twentieth century researchers began exploring the possibility of using the ability of DNA to store and process information beyond the borders of biology. In 1994 a principle study in the US showed that DNA can be used to solve mathematical problems. To date research on DNA computers is primarily engaged in

the study of processes in cells that can be seen as logical calculations and only then to seek how to use these calculations in our favour.

### The first DNA computer

Leonard Adelman, professor of computer science and molecular biology at the University of Southern California, USA, is a pioneer in the field, who built the first DNA-based computer (LM Adleman, Science 266, 1021-102; 1994 [PubMed]). Intrigued by the huge capacity of the DNA molecule to store information in a very small space, he set out to solve a classic mathematical puzzle - the so-called 'Hamilton path' problem, better known as the 'travelling salesman problem'. This is a seemingly simple puzzle - a vendor should visit a number of cities that are connected by a limited range of roads without passing through any city more than once.

Even the most powerful supercomputers will take years to calculate the optimal route for 50 settlements. Adelman solved the problem for seven settlements within one second, using DNA molecules in a standard tube. He presented each of the seven cities as separate, single-stranded DNA molecules, 20 nucleotides long, and all possible routes between the cities as DNA molecules composed of the last ten nucleotides of the city of departure and the first ten nucleotides of the city of arrival. The mixing of the DNA strands with DNA ligase and adenosine triphosphate (ATP) generates all possible random paths between the cities.

The majority of these roads however, were not applicable to the situation - they were too long or too short, or they did not start or finish in the correct city. Then Adelman filtered all roads that neither started nor ended with the right molecule and those without the required length and composition. All other DNA molecules represented a solution.

Source: Computing with DNA. Jack Parker.  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1315819/>. EMBO Rep. 2003 Jan; 4(1): 7-10.  
doi: 10.1038/sj.embor.embor719. PMID:  
PMC1315819

## Ehud Shapiro's Molecular Turing machine

One such demonstration of this objective is achieved by the group of Ehud Shapiro at the Weizmann Institute in Israel who built a programmable and autonomous computing machine made of biomolecules. It is modelled on the hypothetical Turing machine, developed by the British mathematician Alan Turing (1912-54) in 1936 - a device that converts information from one form to another, operating with a terminal sequence of characters. Shapiro's machine uses two 'inputs'. Based on a series of rules for the transition, the machine changes its internal state according to the current state and input until it reaches the 'end state' when all inputs are processed. Shapiro's 'Automater' uses restriction endonucleases and a ligase as 'hardware' in order to change the state of the machine, and a double stranded DNA as inputs and transition rules. The DNA 'software' is constantly ligated and cut by the enzymes until it reaches a final state - a certain sticky end - to which it is ligated with the DNA-'reporter', and thus the calculation is terminated.

Source: (Y. Benenson et al. Nature 414, 430-434; 2001 [PMC free article] [PubMed]),

And here is news from 'Nature' (June 2013): "Plants perform molecular mathematics. Arithmetic division directs use of energy from the plant at night."

Plants do so that the reserves of starch produced by them during the day could withstand almost exactly to dawn. Until recently, scientists thought that starch is

broken down with the same fixed rate throughout the whole night. However, it was found that the small weed *Arabidopsis thaliana* can calculate the speed of decomposition in progress when exposed to unusually early or late night.

The team of Alison Smith and Martin Howard from John Ince centre, in Norwich, UK, believes that the base is a complex molecular calculation. Scientists assume that there are two molecules: S, which shows how much starch remains and T, which informs of the time remaining until dawn. They have found a mutant of *Arabidopsis thaliana*, which cannot change the rate of consumption of starch in response to the particular situation. This suggests that the mutated gene, PWD, regulates this response in normal individuals and may be an important factor in the molecular calculations of the plant. (Ledford, 2013)

Recently the idea whether the universe is a giant computer is also seriously discussed; i.e. calculations are extrapolated on the physical world. (Zenil, 2012)

This requires looking in more detail at the relationship between energy and information in the light of some recent research results:

### **Landauer's principle**

Roughly speaking, the Landauer's principle holds that at the erasing of one bit of information a specific amount of heat should be released. (Source Wikipedia)

Recently this principle has been experimentally proven by a team of Austrian, French and German scientists. In this experiment, a tiny silica bead fluctuates with equal probability between two energy wells (states 0 and 1). Thus, the bead models an information system storing 1 bit of information. The bead is controlled by optical squeezers and is made to occupy only one of the



two equally possible energetic states. This turns its probabilistic distribution equal to 1 and thus the 1 bit of information, which characterizes the experimental system, is erased. The erasure is coupled with the release of a certain very small amount of heat, which is very close to the theoretical value, predicted in the Landauer's principle.

### **Shoichi Toyabe's experiment: Information converted to energy**

Although the basic content of Professor Shoichi Toyabe's experiment was outlined and considered more than once, I allow myself to reproduce an essential part of the exciting article by Edwin Cartlidge, published in *Physics world*.

^The experiment consisted of a 0.3  $\mu\text{m}$ -diameter particle made up of two polystyrene beads that was pinned to a single point on the underside of the top of a glass box containing an aqueous solution. The shape of an applied electric field forced the particle to rotate in one direction or, in other words, to fall down the potential-energy staircase. Buffered by the molecules in the solution, however, the particle every so often rotated slightly in the opposite direction, allowing it to take a step upwards.

By tracking the particle's motion using a video camera and then using image-analysis software to identify when the particle had rotated against the field, the researchers were able to raise the metaphorical barrier behind it by inverting the field's phase. In this way they could gradually raise the potential of the particle even though they had not imparted any energy to it directly.

### *Quantifiable breakthrough*

In recent years other groups have shown that collections of particles can be rearranged so as to reduce their entropy without providing them with energy directly. The breakthrough in the latest work is to have quantified the conversion of information to energy. By measuring the particle's degree of rotation against the field, Toyabe and colleagues found that they could convert the equivalent of one bit information to  $0.28 kT \ln 2$  of energy or, in other words, that they could exploit more than a quarter of the information's energy content."

Source:

<http://physicsworld.com/cws/article/news/2010/nov/19/information-converted-to-energy>

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There are informational interactions in the world, besides the causal ones, as well. Modern science interprets and explores information in terms of thermodynamics. More precisely as entropy reversed - negentropy. It considers informational processes as thermodynamic and more generally as probabilistic. Information is regarded most frequently as encoded in the probabilistic thermal fluctuations of the microparticles, which may have either a zero or a nonzero value.

Information processes themselves are those in which a work is done or heat is produced that is not related not with the change of the current physical structure, but of the probability distributions of the behaviour of the dynamical system.

Information processes can be interpreted both thermodynamically and epistemologically: From a thermodynamic point of view Information interactions are associated with the energetic effects, leading to a change of the probability distributions of some dynamics. Basically, they are related to the reduction, or vice versa - the increase in the degrees of freedom of the dynamic behaviour of the system. The reduction of the degrees of freedom is accomplished by disposing of entropy in the environment; this from a thermodynamic point of view is equivalent to release of heat. In contrast, the increasing of the degrees of freedom is equivalent to an increase of the entropy of the system, which requires its 'heating' with external energy.

This process is equivalent to the process of change of the phases of the aggregate state of water. We know that freezing water releases heat, while the melting of ice requires additional heat. Note that the heat does not lead to the increase or decrease of the water temperature; ice at 0° C absorbs this heat and is converted into liquid water at the same temperature of 0° C. This is the heat associated with the change in the probability distribution of the degrees of freedom of the thermodynamic system; or in others words, it is heat, related with the change in the information state, the negentropy of that thermodynamic system.

For more detailed information:

The enthalpy of fusion of a substance, also known as (latent) heat of fusion, is the change in its enthalpy resulting from providing energy, typically heat, to a specific quantity of the substance to change its state from a solid to a liquid at constant pressure. When a body is heated its temperature rises for the sole reason that the kinetic energy of the thermal motions of the constituent particles of that body is increased. However, this does not apply to the absorption of heat during melting. In this case, the temperature of this

substance is not changed. The most simple example is given by an ice cube: when heating this ice cube with a starting temperature of say  $-40^{\circ}\text{C}$  and with a mass of  $0,1\text{ kg}$ , then its temperature gradually increases until it reaches the melting point, which is  $0^{\circ}\text{C}$ , then the cube ice begins to melt, but at the time of melting, though the ice cube continues to absorb heat, its temperature does not change until it is not completely melted; it's only then that this ice cube, already in liquid form as water, begins to raise its temperature again.

Enthalpy of fusion is represented by the Greek letter  $\lambda$  (lambda) to yield the formula  $\lambda=Q/m$ , i.e. by enthalpy of fusion is meant the amount of heat (Q), necessary for melting of a crystalline solid with mass  $m = 1\text{ kg}$ , after the melting point of this crystal is reached.” (Source - Wikipedia)

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To take a brief look at the epistemological side of the information processes:

What the cognitive process is doing is that, by acting on the probability distributions of the information flow, it leads to the elimination of their uncertainty, hence to an extraordinary reduction of their entriropy. This may ultimately lead to a unique state of informational openness of the objective reality to a subject, conscious of it, perceiving and feeling it,.

In more detail, we shall pause on some epistemological aspects of information processes at the end of the book, in Part IV: Challenges Chapter 2. Romantic information theory and modern physics of information.

So much for the computational ideologeme.

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### **PART III: CONSCIOUSNESS IN A SEMIOTIC PERSPECTIVE: INDUCTIVE INTERACTIONS**

*Synopsis:*

*To the concept of Gavrilov and the developed by today's science holonomic and computational models of consciousness we'll add a fourth - semiotic model. The formulated hypotheses has its basis in the booming semiotics and biosemiotics as separate disciplines, as well as their endorsement as one of the leading paradigms of modern science and culture, along with that of complexity.*

## **Chapter 1: The inductive interactions - the missing link between causal processes and intelligent behaviour**

### *Synopsis:*

*This section focuses on the missing link within this still insuperable conceptual gap between natural causality and semiosis. In particular, it will address the inductive interactions: context-based interactions in which an object does not respond to the direct impact of a certain physical agent, but rather to the transformed meaning which this agent acquires in the interaction context. A very simple instance of such interaction is the electric current, induced in a metal contour due to its mechanical movement in a magnetic field. The same principle however holds for the intracellular signal transduction chains and also underlies the dynamics of conditioned reflexes. What is essential here is that the environmental context in the latter cases ascribes a totally new meaning to the original physical agent, which hence is interpreted as a mere sign, while the resulting interaction turns itself into a proto-semiotic communication.*

**Keywords:** *causality; semiosis; electromagnetic induction; signal transduction; adaptive behaviour*

## 1.1. Blind Causality

There was time when nature was dead, and blind causality undisputedly reigned in the Universe: Agents encountered themselves and destroyed themselves in a physical or chemical manner. There was also self-organization; order was sometimes increased in equilibrium or nonequilibrium phase transitions. But it was all difference in the outward appearance - static or dynamical, orderly or chaotic, physical nature remained equally dead and blind. - And, all of a sudden, as if for no apparent reason, nature substituted causality with acts of meaning...

## 1.2. Adaptive behaviour

The agents began to act adaptively. Their behaviour became consistent with the context in which it occurred: Imagine a planet moving aside to prevent itself from a meteorite pouncing on it; or, throwing satellites at it, in order to push it out of orbit; or, how an amoeba reacts if an aggressive chemical penetrates into its environment... Had it not been an amoeba but a nonliving substrate - the inevitable result is a chemical interaction, which terminates both the chemical and the substrate. - While the amoeba simply flees away from the aggressor, whereupon both remain intact. - The so called 'fight or flight response' - so characteristic of living beings and unthinkable in purely physical settings. Whatever we say about Le-Chatelier-Brown homeostatic or Belousov-Zhabotinski auto-catalytic chemical reactions, nothing even slightly resembling an adaptive 'fight or flight response' occurs there. I bet that even the most advanced chemistry of self-organization will never witness the escape of one chemical at the very sight of another. - Or, the other way round, a chemical agent



chasing another one within the laboratory in a predator-prey manner.

### 1.3. Significance

Why do things have significance for us?

If a bull enters into a china shop, this doesn't matter at all for the sets of porcelain; as for the bull, I guess that this is just a curious experience; while for the store owner the connotation is crucial.

The driver always turns if an obstacle pops up unexpectedly in front of him; or, he hits the brakes to protect both himself and the pedestrian/oncoming vehicle. Why is self-preservation so important for intelligent subjects?

Take a statue - let it be Michelangelo's David, or the Venus de Milo. And take a very humble person unknown to anyone. That the hands of the Venus de Milo are broken does not matter to her. Whatever part of this unrivalled excellence in marble sculptures - David - is cropped off - it is devoid of any significance for this statue. The matters stand completely differently with our seemingly unassuming subject. Even if a hair falls from his head, this could evoke quite unexpected and undesired reactions in him. It is of great significance for ourselves whether we'll continue to exist and in what a way - whether while alive we'll succeed in satisfying our needs and realizing our goals. But why and how is that possible?

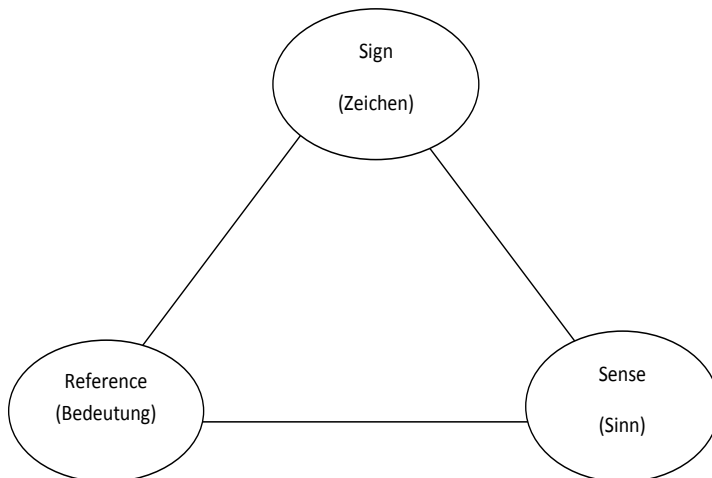
When the firewood has burnt up, the fire just goes out. That the external supply of energy is dried up, and that it would be therefore extinguished, has absolutely no significance to the fire. When the energy reserves of the living body are depleted, it is severely starved; it immediately takes up the demand for fresh addition. Why does the energy potential of the fire bear no semiotic

correlations to its dynamics? Why did such correlations emerge and what are they due to in living beings?

To say that intelligent systems are animate, and this makes their difference from the non-living physical or chemical substrates, is to say nothing. This means to attribute the difference to the divine spark that illuminates the animate subjects. People have committed the Great October socialist revolution; they have discovered special relativity, quantum mechanics and chaos theory; they have invented the TV, the computer, the A bomb, the laser, the Internet and Dolly the sheep; they have walked on the Moon; it's high time for the origins and nature of life and its meaning.

#### 1.4. Semiosis

Intelligent agents are not physical but are semiotic entities. The complexity of intelligent agents is semiotic complexity:



*Fig. 5. By means of a sign we express its sense and designate its reference. Frege (1892)*

For the convenience of the reader, above, we reproduce again Frege's triangle of reference<sup>14</sup> (1892), which we already met in Chapter 1 of Part I (see. Fig. 1). While in the physical world we have interactions only between natural causal agents, in the world of the living, intelligent systems, the 'object' breaks down into something more complicated, which is presented in the above scheme. What was in the physical world an inanimate agent now becomes nothing more than a sign. This sign, however, is subject to semiotic interpretation in which it is assigned a certain objective reference that, in turn, is mentally experienced as a certain concept (sense).

In a purely physical interaction, if say a stone strikes upon a stone, the interaction will be entirely subject to the principles of Newtonian mechanics.

In a semiotic communication, on the other hand, the interaction is subordinated to the principle of interpretation. The physical agent is seen only as a sign, or to be more precise - a signal. The intelligent subject doesn't respond to the immediate physical parameters of the signal's impact, but rather to the reference he has ascribed to the signal through the meaningful act of semiotic interpretation.

From a physical point of view the 'signal' is nothing more than a common physical process. Each physical process, each physical agent may under certain conditions turn into an information signal. However, for this purpose, we must leave the context of causal,

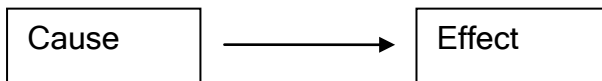
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<sup>14</sup> Frege's complete definition goes like that: 'To make short and exact expressions possible, let the following phraseology be established: A proper name (word, sign, sign combination, expression) expresses its sense, stands for or designates its reference. By means of a sign we express its sense and designate its reference.'

energetic physical forces and interactions and introduce this agent in a new, semiotic context.

Here, the physical process-signal is the herald of another agent that is really relevant to the recipient of the signal. The very response of the recipient is no longer based on the third principle of Newtonian mechanics. The recipient responds to the reference of the acting signal, which is reached after a complex interpretation. - The physical parameters of the signal are not of any special importance for the recipient. What do determine the strength of his response are actually the parameters of the signal's reference, which is ascribed within the communication's settings. - It is sufficient that the citizen that has involuntarily stepped on our foot in the tram apologizes and we almost immediately forget about his misdemeanour. But we never ignore the insult or the threat, or a compliment, even though murmured in a whisper.

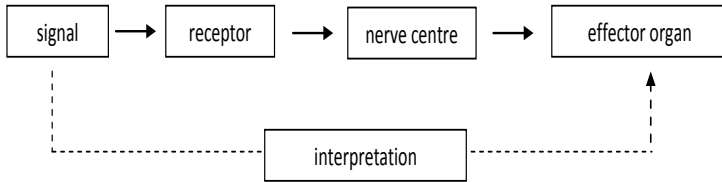
Physical interactions can also be called causal or energetic. They are confined to the effects of the energetic action of certain physical forces (agents), governed by specific, peculiar to them, physical laws.



*Fig. 6. Physical interaction*

Agents in semiotic interactions are signals. Signals are also physical or chemical agents, but their impact is not causal. - First, prior to the behavioural response, the signal is captured by a (specific for it) receptor. The behaviour performed by the relevant effector organ is also preceded by a complex chain of signals transmitted along a reflex arc. This signal transmission is nothing but

processing of the incoming information signals, or in other words - their meaningful interpretation.



*Fig. 7. Semiotic interaction based on a complex reflex arc*

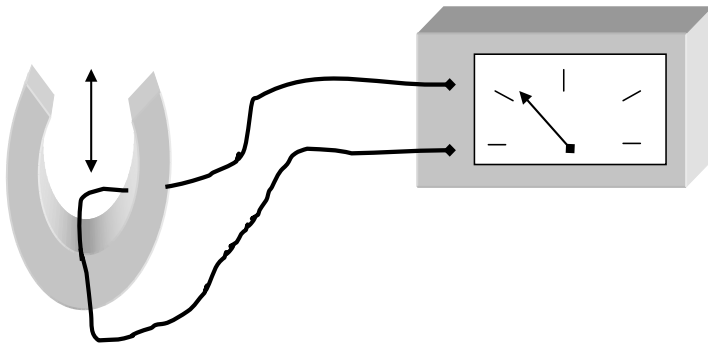
## 1.5. Induction

A meaning is ascribed to an entity through a semiotic act. But where does the semiotic act itself come from? How to get from causality to semiosis? From blind causality to meaningful behaviour? Shall we let the answer to creationism? Or to emergent evolution? Or shall we search for the missing natural link?

Now, we have to make the more difficult transition and to return from semiotics to the true and only reality - that of physics. - Whatever it is in the world of meanings and senses, it has a substantial basis in the world of fundamental physical forces and their causal interactions. Looking historically, semiotic interpretation has not appeared elsewhere and not from somewhere else, but from the universe of the fundamental physical interactions.

So now we must find at least one physical process that could be a physical prologue, or prototype, of semiotic interpretation.<sup>15</sup>

*1.5.1. First, we shall examine the case of electromagnetic induction:*



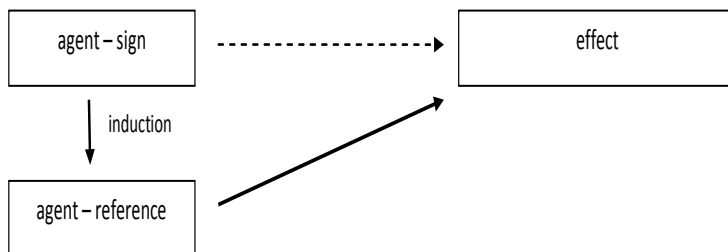
*Fig. 8. The movement of a metal wire in a magnetic field ascribes a new reference to it.*

The movement of the metal loop in the magnetic field induces, 'ascribes' a new reference (meaning) to it. From a mechanical item, it turns into an agent of an electromagnetic interaction. It is not the initially active agent (the mechanical movement of the metal loop), but the new reference it acquires within the context of the magnetic field, that affects the arrow of the ammeter. Within this new, inductive, pro-semiotic context, the original agent turns into a mere sign, while the true agent

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<sup>15</sup> For convenience, we shall allow ourselves to reduce the aspect of mentality from the above semiotic scheme. Preserving just the sign and its reference does not remove its adequacy, as long as the basic principle of semiotics - the moment of interpretation - is preserved.

of the impact on the ammeter is the new *reference*<sup>16</sup> that the electromagnetic induction assigns to it.



*Fig. 9. Semiotic interaction*

*1.5.2. Second, we shall consider signal transduction - the best-studied inductive interaction in biological systems:*

The process of induction in the physical and in the biological systems is in effect the same. It is in both cases an alternative to causal interactions. While causal interaction is always limited to the production of effects, the inductive processes both in the inanimate and the living world are targeted at the production of new references (meanings) of the objects of their impact.

Despite their general kinship with the induction in the physical world, inductive interactions in biochemistry have their own complex specificity, which we shall follow within the process of signal transduction in living cells.

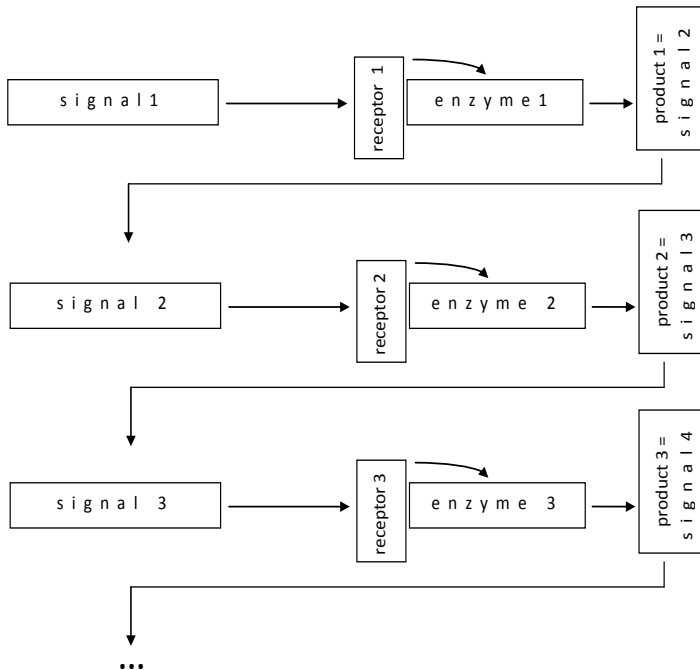
There is no process in a living organism that is not mediated by the transmission and interpretation of biochemical signals. Even the passage of water molecules through the cell walls is not of a causal,

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<sup>16</sup> Here and elsewhere in this communication 'meaning' is synonymous with 'reference'.

osmotic nature, but rather occurs through specific channels, controlled by biochemical signals.

The living body is not a flask in which simmer turbulent biochemical reactions. The picture is different: each biochemical reaction is mediated by an enzyme provided with a receptor, which switches itself upon the recognition of a specific chemical signal; the product of this response is again a chemical signal which is detected by the receptors on another enzyme that converts chemical intermediates into the following chemical signal.



*Fig. 10. Life metabolism as signal transduction*



Signal transduction proceeds in the following basic path:

A signal (ligand <sup>17</sup>) is recognized by a receptor and binds to it. The binding induces a conformation in the receptor molecule, which in turn switches a specific cell protein into an active state. This protein binds with the regulatory centre of a specific enzyme and induces a conformation in its structure, followed by a change in its function, which in turn induces structural conformation and functional change in the next unit of the signal transduction chain.

“Dispersed on the outer surface of the cell are the molecular antennas known as receptors, which detect an incoming messenger and activate a signal pathway that ultimately regulates a cellular process such as secretion, contraction, metabolism or growth. The major barrier to the flow of information is the cell’s plasma membrane, where transduction mechanisms translate external signals into internal signals, which are carried by ‘second messengers’.

In molecular terms the process depends on a series of proteins within the cell membrane, each of which transmits information by inducing a conformational change - an alteration in shape and therefore in function - in the protein next in line. At some point the information is assigned to small molecules or even ions within the cell’s cytoplasm. They are the second messengers, whose diffusion

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<sup>17</sup> In biochemistry and pharmacology, a ligand is a substance that forms a complex with a biomolecule to serve a biological purpose. In protein-ligand binding, the ligand is usually a signal-triggering molecule binding to a site on a target protein. The binding typically results in a change of conformation of the target protein. In DNA-ligand binding studies, the ligand can be a small molecule, ion or protein that binds to the DNA double helix. [http://en.wikipedia.org/wiki/Ligand\\_\(biochemistry](http://en.wikipedia.org/wiki/Ligand_(biochemistry)

enables the signal to propagate rapidly throughout the cell.

[...] The major signal pathways are now known. One employs the second-messenger cyclic adenosine monophosphate (cyclic AMP). The other employs a combination of second messengers that includes calcium ions and two sub-stances, inositol triphosphate (IP3) and diacylglycerol (DG), whose origin is remarkable: they are cannibalized from the plasma membrane itself.

[...] In both paths however, the final stages are similar: the second messengers induce cellular proteins to change their structure. [...] There are two main ways in which second messengers function. In one of them the second messenger acts directly. It binds to the protein (specifically, it binds to the 'regulatory component of the protein') and thus triggers a conformational change. A classic example is found in skeletal muscle. There second messenger calcium binds to the protein troponin C, triggering a conformational change that leads to the contraction of the muscle. In the alternative, more common mechanism the second messenger acts indirectly: it activates an enzyme called protein kinase, which then phosphorylates a protein. The phosphorylation (that is the addition of a phosphate group) induces the protein to change its shape." (Berridge, 1985, 124)

The forces underlying the signal transduction are of a various nature, such as: hydrogen bonding, ionic interactions, Van Der Waals forces, and hydrophobic packing. (*Lodish et al., 2003, 30*) In other words, physically they are quite different from electromagnetic induction considered in the previous subsection.

What is essential about induction, however, regardless of its particular physical mechanism, is that it remains in all cases a non-causal, pro-semiotic act,

which is targeted at attributing new objective references, new meanings to the objects of its physical impact.

Induction continues to be at the core of highly developed semiotic mechanisms, underlying advanced intelligent behaviour. Thus, conditioned reflexes, for instance, are nothing but an inductive mechanism that converts the original neutral meaning of a signal into one bearing a vital biological relevance, as manifested in Pavlov's paradigmatic experiment.

Induction is, generally considered, a mechanism of converting meanings of interacting agents, depending on the interaction context. This is what was observed starting from electromagnetic induction, through cell signal transduction, to conditioned reflexes.

Next we turn to the adaptive significance of the signal transduction as a biological inductive process.

## Chapter 2. Interpretation and adaptation

### 2.1. Interpretation

The receptor can be likened to a switch, a button. Our action upon a button is not intended to cause a qualitative change in the button, but just to switch it to a new active or inactive state. We merely attribute a new reference to the button through our impact. What we actually do is to induce, ascribe a new objective reference to it. This is what induction is always about, regardless of its physical, or chemical, or other character and apart from its level of complexity.

The essence of the inductive processes is precisely in that they are targeted at and result in the change in the meaning of physical agents. Hence, inductive interactions have a pronounced pro-semiotic character. Induction is the mechanism of transition from causality to semiosis. Thus, inductive interactions can be considered precisely as the searched missing link between dead and blind physical nature and the live and meaningful semiotic universe. Induction switches the agents on or off, changing their function, without changing their identity. This is impossible under causal physical premises. Causal physical or chemical interactions result in either a qualitative change in the object of the impact (most often irreversible and destructive), or the other way round - only in a change in its spatial position. Causal interactions either destroy or leave the subject of their impact completely unchanged. Hence they can have no semiotic relevance.

Inductive interactions maintain the identity of their objects and, besides, attribute to them new meanings, dependent on the specificity of the interaction context. Hence, inductive, or we may also call them signalling, or information interactions, are precisely the searched

interactions that establish pro-semiotic dependencies between their subjects.

## 2.2.Adaptation

What kind of reactions takes place in nonliving matter? - Causal chemical reactions. - A causal chemical reaction ends in an effect, e.g.:  $2H_2 + O_2 \rightarrow 2H_2O$

What kind of reactions takes place within the living cell? - Inductive chemical reactions: E.g. the reaction between the primary messenger molecule (PMM) and the receptor macromolecule (RM):  $PMM + RM \rightarrow induced\ RM$ . - An inductive biochemical reaction ends in a new cause. Inductive biochemical reactions result in a chain of induced agents.

This inductive transition chain is comparable to the transformations made in order to solve an algebraic equation. The final algebraic expression is equivalent not only to the previous one, but also to the unknown quantity  $x$ , which is specified in the problem's statement.

Thus the chain of biochemical signal transduction is the inductive mechanism by which the biosystems look for adaptive responses to the complex challenges of the environment. If the interaction between organism and environment was not inductive, i.e. not driven by meanings, but driven by blind causal forces, as any direct causal interaction is indeed, it would have ended with a destructive effect, detrimental to the agent and its counterpart.

Inductive interactions not only transmit signals in the biosystems, but also convert, adapt the systems to their new meanings; to be precise - signal transduction induces specific protein synthesis that is an adaptive, intelligent, meaningful response to the fluctuations in the biotic environment.

Thus, the transmission of information signals between/in biosystems means also their adaptation to their environmental settings.

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## **PART IV: CHALLENGES**

### **Chapter 1: Advantages and deficiencies of the presented four models**

So far there have been outlined:

- Aristotel Gavrilov's model: cognitive image is an open window to the content of objective reality;
- The holonomic model: reality does not have substantial nature; its nature is informational and in particular it is a holographic image;
- The computational model: inherently knowledge is computation (calculation); the brain is a biological computer; computation is possible in the inanimate nature, too;
- The semiotic (inductive) model: intelligent processes differ from causal in their contextually-based nature; induction is a physical process that can provide such a semiotic connection.

Are these models competitive; or, are they in their deep essence identical; or they complement one another, as each of them has its place and function in the complex dynamics of a real and specific cognitive process; or each model (mechanism) shall take effect independently, according to the particular situation and cognitive task? I think it would be premature to ask such questions at this stage; more wisely and productively is that each of these approaches be developed in full detail regarding its greatest strengths and weaknesses when tested in particular epistemological settings.

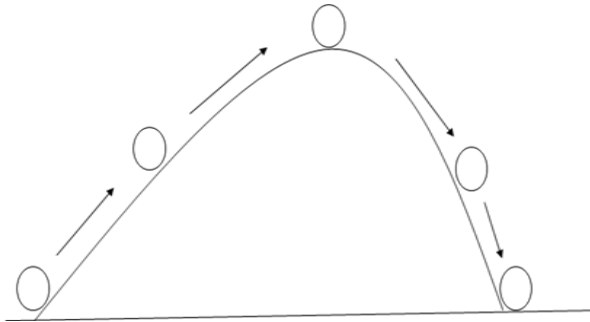
In fact, the purpose and mission of all the above models is the same - to go beyond the phase space of the immediate interactions; to reach the outside context; to include the interaction context and thus to identify and

implement more meaningful, more efficient and more sustainable solutions:

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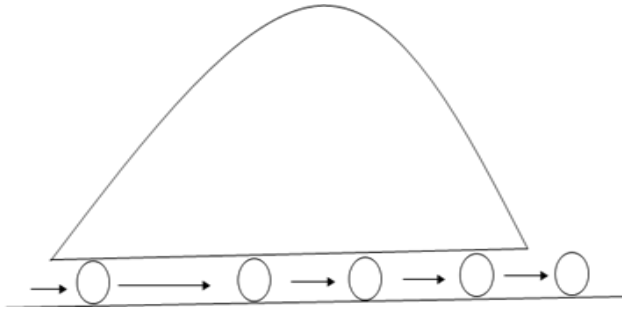
Let's have a metal ball located in the grounds of a high mountain that moves toward its ridge (Fig. 8). It will climb it in case it has sufficient energy. Besides, at any point of its trajectory, it will do the most economical energy consumption. This is an implicit requirement of the conservation laws.



*Fig. 11*

Only a metre, a millimetre away from the path of the metal ball might be located a convenient tunnel (see. *Fig. 12*)...





*Fig. 12*

... but no matter how close to the trajectory of the ball, outlined by the causal powers directly influencing it, this convenient energy-saving transition is, the ball will not take advantage of it.

Obviously, in this case the most energetically sustainable solution is not to be found in the phase space of the immediate causal interactions, the physical material points are subjected to.

This incomparably more efficient energetically solution can be found only if the dynamic system has the capability and means to take into account the opportunities provided by the broader context of its behaviour.

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So what is it that we see? Strictly speaking, this is everything but not what immediately happens to us, in our physical body. If one wants to know what is going on in there, he will have to take an X-ray, MRI or ultrasound. Is it not strange that our nature is so constituted, as to be overwhelmed by the flow of events that most often does not concern us, and we know almost nothing about the

actual physical, chemical, etc. internal processes, within us, or more precisely, that actually we are?

Indeed, our internal receptors constantly inform us of our own physiological state, but first, over 90% of the information we receive comes through the channels of the visual modality that relates exactly to what doesn't concern us (immediately); secondly, we do everything possible not only to ignore but also, through the use of various 'healing' substances - delete the most important internal information, about the critical state of our organs and tissues<sup>18</sup>. As we wonderfully understand, all that's not by accident. Of all the processes taking place in the universe, actually the most important to us are precisely those in which we are not directly causally involved. - Because we are not physical objects, but knowledgeable and capable intelligent actors who know how to control their lives and their world precisely through their knowledge and their control over the hidden power and energy of the external context of their behaviour.

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To start with the inductive model:

Its strength is that it reveals a possible direct link between a physical process and its context - something which standard causal processes are incapable of. With this, the inductive processes can actually prove to be the missing link in the inexplicable transition from blind, causal to pro-semiotic, pro-semantic and thus meaningful connections and effects.

The weakness of the inductive model is that for now it cannot simulate the state of mental awareness, the Holy

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<sup>18</sup> Or, as it is written on the advertising of such a product: 'Life without pain'. (I'm not sure about its name.)

of Holies of human consciousness<sup>19</sup>. Second, the inductive processes occur spontaneously, similar to the standard causal processes. This means that in their deployment they don't provide role for conscious volition; indeed, they can reach the context of the processes, but whether and what relationship to the context will be implemented (because it is not even clear whether this relationship will not prove to be destructive)?

I'll stop here; we live in an age of radical self-PR, where self-criticism is seen as infantilism. Let's stay with this: induction for now remains the only known real, physical connection between a process and its context with which it finds one, though still fragmentary studied and described horizon to contextually-based, i.e. rational behaviour. In this sense, the induction might be a beam to or from the light of reason.

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Before proceeding to the computational model - a note of a more general nature:

There are scientists who tend to think that the appearance of consciousness is an emergent act. From their perspective, the attempt to deduce the emergence of consciousness as a cumulative chain of standard, universal physical interactions, processes and their evolution is untenable. For information of the younger readers, such was precisely the approach of the

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<sup>19</sup> In fact, we know a lot more of the original tabernacle - the Holy of Holies: the room in which are stored the Ark of the Covenant containing the tablets with the Ten Commandments, and also the blossomed rod of Aaron, and a sealed jar of manna. (<https://bg.wikipedia.org/wiki/Кивот>).

founders of the Marxist theory of reflection, as well as of earlier materialists, indeed - cumulative - to search for a primary property in the foundation of matter, which evolved into human consciousness.

My aim is neither to criticize nor intercede for emergentism or cumulativism. - Cumulativism can easily degenerate into preformationism where at the beginning we are given what we want to deduce through a complex evolution. Emergentism could even more easily slip to agnosticism. Rather, my goal is to defend a free analysis of the evolution of consciousness that is not afraid of any labels, which loosely follows the rationality and the intuition of the intelligent, ideologically unburdened yet tempted contemporary - the actual target group of any authentic philosophical discourse.

In this sense, yes, here we are looking for natural prerequisites for the origin of consciousness, starting with the earliest stages of cosmological evolution and the most fundamental physical forces and interactions.

Even if it turns out that consciousness arises spontaneously and emergently at a given evolutionary stage; even be that its appearance has nothing to do with the forces and any of the physical agents acting at this stage, nevertheless - that stage of the history of the universe should be precisely identified and the links or absence of links with the emergence of consciousness at this stage must be accurately documented and justified.

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Calculation is a process in which the real physical structures and processes are converted into mathematical objects and operations with them, with the result that we get new knowledge relevant to the real

objects. E.g.:  $16 = 7 + x$ ;  $x = 16 - 7 = 9$ ; 16 can be apples; 7 can be yellow; x can be red. But the calculation is much more: it can tell us about the number of planets in our solar system, the age of the universe, the age of archaeological artefacts and paleontological findings; things that we cannot see immediately, but could be a ground for a much more sustainable and effective - contextually-based, that is intelligent behaviour.

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There is something significant in common between the computational processes and those of self-organization. It is that both types of processes reduce complexity and increase the systems' order. But there is a fundamental difference in the way they achieve this.

The calculation is possible based on the preliminary hierarchization of the mental content. In particular, in summation, the elements are pre-ranked in a hierarchy of classes.

Curiously, spontaneous hierarchization is possible in the self-organizing systems, too. For example, the wind not only scatters the fallen autumn leaves, but can also put them into piles. Not only them. On the ceiling of our rural house I could see with my eyes that the snow, penetrated through the cracks in the roof has arranged itself into cones. I.e., it wasn't spread evenly on the floor in a formless snowdrift, but had formed three identical and situated at spaced locations perfect cones. Spontaneous causal hierarchization is even better known thanks to the phenomenon of fractal self-similarity - many biological structures: organisms, organs, or tissues have a fractal structure that is preserved at almost unlimited change in the physical scale.

Regardless of this curious but misleading coincidence, computational order is based on entirely different grounds. It starts with choosing of an appropriate base of the numbering system. Normally we use the decimal system, but it is interesting and useful to note the origin of other numbering systems as well - e.g., the duodecimal: „...the importance of the number 12 is usually linked to the fact that lunar cycles in a year are 12, or such is the number of the phalanges of the fingers of the one hand (three on each of the four fingers, the thumb is not considered).’ (<http://www.introprogramming.info/intro-csharp-book/read-online/glava8-broini-sistemi/>)

If we choose to represent the decimal number 13 662 by duodecimal hierarchical notation, it will be 7AA6, in which there is nothing special, except that the sorting base is already the dozen (i.e. not the fingers but their phalanges), and that besides the numbers 0 to 9 appear two new A = 10 and B = 11.

Once organized into a hierarchal order the matter of thinking is processed (calculated) with simpler and more efficient operations. So things are manageable, perspicuous; converted into a form suitable for their mental manipulation and rational control.

Thus the distinction between the pro-informational processes of self-organization and the process of computation gets clear. Self-organization proceeds spontaneously under the effect of causal physical forces. Computation is instrumental. It uses specific tools for the production of knowledge: abstract objects, symbols, rules of inference, algorithms, computer programs...

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We know much more about how to calculate, than what this actually means. Why is it necessary to calculate at all?

The trivial answer is that it is more economical and more efficient. Which again brings us to the point that the computation reveals things that we cannot see directly and which could, however, be grounds for their more sustainable and effective - contextually-based - consideration.

So it is in a rational, whether individual or social context. But calculations have a place as an event in a causal physical world and, if so, what could be their function there? Do calculations have a role and a function in physical interactions? Does nature need to calculate?

If we are looking for straight analogies, so yes, nature can definitely 'sum'; mass is an additive value; besides, nature can 'subtract' and 'divide'; these are all physical processes governed by causal laws of physics. Furthermore, even the most sophisticated mathematical and logical operations are accomplished by a hardware based on standard physical processes. Moreover, we know almost nothing about our mental states and acts, yet what we do know for sure is that they are also the product of neurophysiologic processes that could be based on nothing but the standard fundamental physical interactions.

If by calculation we will understand the operation reducing the informational uncertainty of a system, so yes, in nature, there are spontaneous transitions of self-organization, which reduce the entropy of thermodynamic systems, too.

But the calculation is not just an operation or a process; it has a role and a function. We calculate something in order to use it in a 'target' chain.

I would hold that nature calculates if there arises such a situation:

For example, I need to calculate what transportation from the city A to the town B is more acceptable as security, cost, time and comfort. And if some data are missing, I cannot continue my journey, respectively, I do nothing until I finish the calculation.

Let's say now that in nature happens something like this: a meteorite is sweeping to the Earth and it's torn on what orbit to take: one that lands it in Moscow; or this - in Washington; or as a popular radio whispers: 'Sofia is also a nice city.' And the meteorite stops halfway waiting for additional data.

But there is a more serious interpretation. According to it, in inanimate nature, there are long-term and wide-range correlations that have no direct (immediate, 'here and now') causal nature but are evolutionary. To manifest and notice such correlations, generations are required, historical, geological, perhaps cosmological eras.

"Explosions are also compressions of time. Observable changes in the natural universe all are explosive to some degree and from some point of view; otherwise you would not notice them. Smooth Continuity of change, if slowed sufficiently, goes without notice by observers whose time/attention span is too short. Thus, I tell you, I have seen changes you would never have marked."

Frank Herbert, "Heretics of Dune - Leto II"

<http://elboneyard.org:8088> - Accessed February 12, 2016



The Interference of: cosmological, evolutionary, social and other macro-correlations and immediate ('here and now') causal interactions may indeed imply a situation of 'search', and 'choice' of 'decision', and perhaps it might really lead to 'calculations'?

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## Chapter 2: The romantic theory of information and the new physics of information

The concept of information is very convenient as a measure of the extent to which we know the things. - But very uncomfortable as a base camp to the heights of consciousness.

In 1948, came out two fundamental publications on information. One is the article 'Information Theory' by Claude Shannon in which he offers his famous formula on measuring the amount of information and from which it is clear that it is the same as another fundamental formula - of entropy, by Boltzmann, but with a reversed sign. Although Shannon's proper goal did not include the study of the nature of the information, but only the accurate measurement of its amount flowing through the channels of communication, the identity of the measure of the two quantities - entropy and information - had a powerful resonance in physics and natural science in general, that induced not less far pronounced philosophical aspirations. As far as the theory of communication and thermodynamics especially, are solid substrate theories, the hope was to get to, on their base, a fantastic philosophical result, namely the substance of knowledge.

That hope was fuelled particularly by the other landmark publication in the same year - 'Cybernetics' by Norbert Wiener, in which he states the iconic phrase: 'Information is information. It is not matter or energy.'<sup>20</sup> that gives a most authoritative scientific sanction to the

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<sup>20</sup> 'Information is information, not matter or energy.' Cybernetics, 2<sup>nd</sup> ed., p. 132

substrate treatment, if not to say - the materialisation of information.<sup>21</sup>

Let's add to this the unwavering attitude of everyday consciousness that information and knowledge is the same. When we add to the sum the not less persistent attitude of scientists to interpret information as a substrate we'll fully understand the reciprocal enthusiasm of philosophers to get their hands on the Holy Grail, if not on the substance of knowledge and consciousness.

Such enthusiasm in retrospect is naive. But doesn't in the foundation of any epochal event stand a deception, an illusion, an adventure or a dream? Didn't people land on the Moon captured by their childhood dreams or by the sacred archetypes of the generic subconscious? Didn't Schliemann discover Troy, led by the belief in an ancient legend in which the actual characters are more problematic than their divine sponsors?

Although sometimes it's just the opposite - today we are convinced that Columbus was looking for a western route to India, but the maps that apparently were available<sup>22</sup> to him and the revolutionary type of navigation<sup>23</sup> of his fleet speak otherwise.

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The 'informational collapse' was just such a romantic substrate conception about information. To think about

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<sup>21</sup> Although, as we know, his purpose was just the opposite.

<sup>22</sup> [https://bg.wikipedia.org/wiki/Пири\\_Реис](https://bg.wikipedia.org/wiki/Пири_Реис)

<sup>23</sup> Columbus' fleet has used underwater navigation; otherwise it could not have got away from the Mediterranean through the Strait of Gibraltar and to embark on a course to the New World.

the collapse of information implies that it should be seen as a substance in which processes similar to those in physical systems take place. But to identify information with knowledge and take information itself for a substance is naive.

Only the data signal can be considered as a physical object. But without its interpretation, it has no information content. Any 'information content' or 'substance' whatsoever is absent from the information signal.

It is obvious that the interpretation itself does not hold any information content or substance of its own that it could assign to the information signal. - Because if the interpretation had them, there would be no need for data signals. It is equally clear that if the signals were carrying informational content or substance themselves, there would be no need for interpretation.

But then how to supersede this romantic picture of information interactions? Is a physical theory of information possible and what does it refer to today?

Yes, a physical information theory exists. It is precisely it that the Landauer principle and the Toyabe experiment are based on. As we have seen, informational physicists do not treat information as any substance whatsoever, but as a process. The essence of this process lies in the fact that an agent applies external power to change the quality framework of the probability distributions of the dynamics of another agent.

The strength of this approach is that it finds a sustainable substrate of the information processes and, it seems, it will be able to retain at least some of the significant points of the romantic theory of information.

Say, the hypothesis of the informational collapse: it remains a possible event opening a horizon to the generation of mental states. Indeed, now an informational substance that can accumulate to a supercritical amount beyond which starts its irreversible

collapse is absent. Nevertheless, there remains the theoretical possibility that, based on the impact on the structure of the probability distributions of the dynamics of a system, an accumulated critical mass of information can undergo an informational collapse, leading to the physical analogue of the mental state - the informational singularity.

The other significant point of a romantic theory of consciousness that remains valid under the new physical theory of information is Aristotel Gavrilov's model. This is a fortunate consequence, because it is a beautiful epistemological model. Gavrilov's model is exquisitely economical in view of the metaphysical entities with its insistence that we do not need any substantial accessories in order to see and understand the world; on the contrary, the epistemological image is just a window open towards objective reality.

On the occasion of this model one recalls about 'Occam's razor': 'Entities must not be multiplied beyond necessity'. - And more, Michelangelo's principle - to remove all superfluous from the marble rock and thus reach the exquisite sculpture. - In the ontological picture of today's physics of information, information processes are similarly related solely to the effects that remove the probabilistic uncertainty and thus focus, clarify and brighten the macro-framework of the probability distributions of the systems' dynamics.

The cognitive image, from this perspective, is a special condition that should spontaneously arise in a thermodynamic system as long as it has reached a critical point, a specific state of its information dynamics. This would actually be a state capable of informational openness to the object of perception and in no case could be a metaphysical doubling of the real object in an imaginary world of mental entities.

Like the reader, I've been struggling with the mystery of where the mental image might be; even I planned to title so this last book's chapter. But now, it turns out that not only with regard to Gavrilov's theory of consciousness, but in view of the model of the information processes adopted by today's information physics, mental images do not exist.

They are to be found neither in the human head, nor are they projected onto the physical objects of our sensory experience. They are not any physical holograms, nor ghostly mental beings hovering now in our brains, now in our 'consciousness' or in some cosmic super-consciousness, now in a holographic projection, then in the physical world. Mental images, in the sense of any material or ideal objects existing outside and independently of some other, different from them 'original', do not exist.

What actually exists is a specific state of *awakening* of the information subject about objective reality - a state of openness, of conscious awareness. This state, in view of modern physics of information occurs when an information system amasses a critical amount of information. Then, the window of its communication with the world spontaneously opens and this real world becomes its subjective proprietorship - what we also call: feeling, perception or knowledge of objective reality.

However, if we still assume that information is a physical substance, enjoying an equal ontological status with matter and energy, the idea of the informational collapse is still compatible with such a concept. Then, an informational collapse should occur in an information machine (computer), provided that the critical amount of information necessary for the occurrence of an informational collapse<sup>24</sup> is stored in its active memory. In

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<sup>24</sup>  $I_{\text{collapse}} = 2M_{\text{Sun}} C^2 / kT \ln 2$  (bits)

fact, in that same moment it can be assumed that the fantastic event has already happened - the information machine has acquired the ability to be aware.

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**Assen I. Dimitrov**  
**SCIENCE AND CONSCIOUSNESS:**  
**MODELS AND CHALLENGES**

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