FORMAL THEORY OF SEMANTIC AND PRAGMATIC INFORMATION - A TECHNOCRATIC APPROACH

Venco Bojilov

Abstract: *The actual development of our civilization on Earth in the last century has seen an explosive growth of meaningful production, manipulation and use of information. Unfortunately, we still rely on an intuitive notion of this phenomenon, and even some of the leading experts avoid giving a precise definition of this development. What is more important - the explosive increase of the capacity to exchange signals over the past two decades has brought an overall reduction of the information in the communication flow, rather than its integral growth, and its allegorical approximation is closer to the level of relict infrared radiation of the Universe, rather than a typical star's optic or UHF emission. The other side of the coin is the exponentially growing complexity and linked with it impracticability of relevant functions which make use of such information.*

The paper describes an approach for effective framing of the so called semantic-pragmatic information and a relatively simple formal structural model of a subject which uses such information, as a set of properties of this paradigm, concerning the boundaries of possible information consumption in real natural or artificial systems in the Universe. As formulated, these properties govern:

- The limitations on the amount of information and information exchange in real subjects / systems;

- The conditions for converting Information into Noise and vice versa;

- The principles of growth of proper pragmatic information in a natural subject /system during its physical existence/"life";

- Asymptotical reduction of communicated information among so called "Teleological" or "Autopoietic" (i.e. self-expandable, self-steering and self-developing) systems during their post-mature evolution.

Some interesting consequences of the identified properties are outlined, that can have a great social relevance both now and in the near future.

Keywords: *Semantic Information Theory, Framework, General System Theory Class, Instance Definition.*

ACM Classification Keywords: *H.1.1 Systems and Information Theory, Value of information*

0 Fundamentals

The evolution of human civilization on Earth for more than half a century ago has led to the creation of an artificial Turing machine, which now allows the subtraction of Man from the virtual process of "manipulation" of pure information. The need for formalization, respectively an opportunity for (both qualitative and especially quantitative) assessment and subsequent ability to engineer and construct new systems, requires the creation of a formal model of semantic and pragmatic information, similar to the established in the middle of the 20th century model of quantitative assessment of the physical information entropy metrics in communication channels, mainly in the work of Claude Shannon [Shannon,1949].

The need for such formalization of semantic information was first encountered 30 years ago during the author's efforts to find an effective way to synchronize parallel 'write access' to very large relational databases, and then 4 years ago, during the author's participation in the TWG NZ of INSPIRE phase 2 [Inspire2012]. The recent problem (in [inspire2013]) was how to deter a "formalization abuse" in the proposed duplicated full (!) re-formalization of the surrounding world, which is always to some extent subjected to natural disasters. Below is offered a new framework and a set of interconnected formal statements that define the conceptual paradigm for application of semantic operations (analysis and synthesis) and the corresponding mandatory frame of object-pragmatic information. This model is part of a more general project, which is currently still under development and awaits finalization and publication. Part of this larger project is the minimalist diagram sketched in annex 1, which represents an extended hierarchical multilayered concept model of the Universe, based on L. Bertalanffy's one [Bertalanffy,1969] .

0 - 1 (Philosophical basis of pragmatic semantic information theory)

Actually, the notion of Information is still an intuitive concept, mainly because of its fundamental categorical level, similar to that of physical matter. So, Information as a phenomenon is still discussed in a largely philosophical context and is often seen in the framework of the so-called "basic philosophic question" (BPhQ) of the primacy and general relationship between matter and consciousness (implying our human consciousness) in the works of Hegel two centuries ago. The persistence of this philosophical question is a vivid illustration of Gödel's theorems of incompleteness and complement [Gödel,1931], but in this case - applied in the context of a total knowledge as a theory description: the Cosmogony as a systematic descriptive theory of our world with the Civilization of Homo Sapiens in it. The reduction of this complement (i.e. the fix of one of the alternative solution of BPhQ) can be done by increasing the internal structure entropy capacity (Kolmogorov's entropy in [Kolmogorov,1965]) of such

theory. This is a process of expanding the knowledge contained therein, until reaching a frame with a minimal trivial complement (!) that remains outside the scope of that "major" philosophical question (the problem of formal knowledge expansion and reduction of the Complement is partially addressed in Lemma 8, Lemma 9 below in the text).

The solution to this fundamental philosophical question (and in particular the problem of the origin of information) can be examined in two alternative methodologies/ paradigms of the type:

A) is there a theory to explain the creation of consciousness from matter, with a minimum complement;

B) is there a theory to explain the creation of matter from some intangible Consciousness (e.g. dreaming at night of a Golden Pyramid in your yard, and then finding in the morning that it has emerged there namely golden, but not as an earth cone produced by a volcano or the activity of moles ..)

Under option B), which represents our inherited religious Cosmology (in the Bible: " Then the Lord God formed a man from the dust of the ground and breathed into his nostrils the breath of life, and the man became a living being. ..." [Genesis 2/7], we already have a logical contradiction. The use of material components, dust from the earth, is an essential step towards the creation and materialization of consciousness and this interrupts (!) the validity of the concept of pure consciousness-based creator. However, the problem of the validity of option A) is still open at the level of insufficient theoretical, matter based description of the phenomenon of "consciousness". Development of the theory of pragmatic information, especially in the context of a 5-level hierarchical cosmogonist model of the Universe (see App. 1) allow us to overcome this problem and to move towards finalization (and subsequent usage of option A from above), as well as to "close" the "basic philosophical question ".

The methodology of solving BPhQ has two explicit alternatives:

A) - Hierarchical physical development of nature to the stage of "consciousness" as property or implementation of a structured material system from the bottom up;

B) - Differentiation / deconstruction from top-to-bottom of the consciousness components until reaching elementary unstructured matter.

Very often there appear eclectic-scholastic approaches of specific unification of the two methodologies: first from the bottom up, then differentiating from the top down, hoping to hit a point of connection of the so called "materialistic" and "idealistic" approach. Experience shows, however, the impossibility of creating a successful theory, description or paradigm based on such combined methodology, due to the exponential, even factorial multiplicity of opportunities as a function of the holistic complexity dimension of the modeled object. Below in the presentation, a materialist approach (type A) of methodology will be used (i.e. building bottom up) in creating complex-structural representation of a physical object that is able to perform all the familiar elements of our "Ideal" – a mentally enabled entity.

0 - 2 (Framework of the information paradigm)

Modern information paradigms always use at least two entities that interact with each other and as a result of such interaction, transmit and exchange information. A good example of the status quo is given in [Markov at al 2007]. To be able to get out of the trap of Gödel's incompleteness, we can take these entities not only from the non-provable version of the arithmetic sequence of natural numbers, but also from the convenient real Cosmogony of the material world, based on the current knowledge of the civilization and relevant materialization/objectification of at least one entity - participant in the information process. Here, by "real cosmogony" we will understand not just theories about the origin of the primary matter in the universe (i.e. [Alfven, 1984]), but knowledge of all (hierarchical) levels of structuring the surrounding world. The talks of a virtual "information field" in outer space, which we do not know enough, we shall consider another non-provable form of Gödel's complement which shall replace the missing knowledge. More than a century and a half ago such comprehensive hierarchical Cosmogonies were deployed by leading thinkers of the emerging Industrial Age. Friedrich Engels, for instance, had accepted a natural hierarchy of knowledge in terms of physics and mechanics (1), chemistry (2), biology (3) and sociology (4), and its corresponding real hierarchy of the material world.

Similar ideas are discussed implicitly in the general systems theory of Ludwig von Bertalanffy [Bertalanffy, 1969], which will be used as a basic paradigm for our construction, and there we can identify in comprehensive manner three (lower) levels of physical/material interaction:

- the Subatomic physical level of types of gravity and nuclear forces, energy radiation;
- the Chemical-electric level of the atoms from Mendeleev's table;
- Mostly the dynamic, cyclically-stable bio-chemical level of the living cell - in the colloidal complex chemical composition of the living cell,

and in addition, completely superficially, the socio-psychological level - Homo Sapiens and its civilization.

Multi-level hierarchical cosmogonies of the natural world are also discussed briefly by Mesarovic, Mako, Takahara in Chapter 1, pt. 3, of their fundamental *Hierarchical System Theory* [Mesarovic at al, 1970]. The top level of the civilization as an organism (!) is first mentioned (according to [Bertalanffy, 1969]) by Spengler [Spengler, 1922]. Modern extension of civilization oriented systemic level is discussed in [Luhmann, 1986]. Newer (natural) hierarchical structure of the Universe is offered by Sirotkin [Sirotkin, 2011] (see fig. A in Annex 1). An alternative to such casual observable hierarchical structures is proposed in the five-level hierarchical structure (see fig B, Annex 1), which is based on the functional structural characteristics of the different hierarchical levels, according to the structuring pattern at the lower levels and partially at the Civilization level in von Bertalanffy's works.

From the point of view of the multi-level hierarchical Cosmogony, any one entity from any hierarchical level can interact with other entities (both at its own and other neighboring hierarchical levels), but the majority of these interactions appear as purely energy – matter exchanges, i.e. as conversion of a local state of matter into another state of matter, in accordance with the acting physical or chemical forces / laws in the proximity of the subject.

Here is the point to fix the definition of the concept of information, which we can further finalize in deterministic formalism of the presentation of semantic information in the paradigm of the five-level structured material world.

Norbert Wiener [Wiener, 1961] gives a good almost philosophical definition of information - as "not matter or energy". Assuming such concept framing, the following text is trying to find practical and useful representation of this philosophical definition.

0 - 2A (prerequisites)

In order to talk about an information-based (intangible) interaction, first a requirement should be imposed concerning the relevant material (hierarchically classified) structure of an existing detached sustainable entity (either subject or object in the process of interaction), and this interaction should not violate / consume / amend substantially the entity's integrity, so that it will maintain (or resume) in time its characteristic appearance and conditions, both before the process of information interaction and after its implementation / completion. Obviously, structures of the first hierarchical level with their nuclear forces (e.g. the collapse of Uranium-235), structures of the second hierarchical level with their electrical and chemical interactions (e.g. oxidation of calcium or carbon), and structures of the third hierarchical level with their material flows in or out of the cell envelope, supporting the dynamic steady state of the respective complex chemical solution, or the balance of anabolism and catabolism in the cell "reactor", all cannot be qualified as information interaction according to the above framework requirement. It must

be explicitly noted about the 3rd level– the living cell - there is no prominent EXTERNAL observable information process (despite the mandatory INTERNAL information- and cybernetic-based metabolism, well modeled by the cybernetics-based Mazur Information theory in [Mazur, 1970]. So, level 3 is intentionally ignored in the foundation of semantic and pragmatic information paradigm of the natural word, because of his material and energetic aspects contradicting Wiener's definition.

Information interaction between two entities we can posit exclusively with respect to the participation of entities from the 4-th level of the structural hierarchy - animals (or equivalent artificial structures).

> In his system analysis of advanced living organisms, von Bertalanffy describes a component of the classical framework of the information process, which is the phenomenon of information excitation: Pütter's theory [Pütter,1920] extended by Hecht [Hecht, 1931] considers the formation of excitatory substances from sensitive substances (e.g. light-sensitive purple rods in the eye of the vertebrates) and their disappearance as the material base of excitation. With regard to these processes, production and elimination of excitatory substances, quantitative relationship of sensory excitation (in the animal), we obtain the following on the basis of chemical kinetics and the law of mass action: threshold phenomena adaptation to light and darkness, intensity discrimination, etc. This hypothesis of stimulating and inhibiting substances and a mechanism of dissimilation/catabolism under the influence of (external) stimuli is based on the theory of [Rashevsky,1938] on neural excitation by electrical stimulus in a biological organism. The occurrence of the specific substance sensitive to light, and accordingly, its decomposition under the action of light, does not lead to degradation of the hosting organism - the eye as an organ of a vertebrate animal. On the other hand, a similar reaction at a lower hierarchical order, for instance the bombardment of the crystal of carbon by oxygen atoms and molecules gives rise to carbon dioxide gas, but not to a reversal of the process, which would be the reduction of the crystals and the recovery of the oxygen atmosphere.

Regarding the organisms at the 4th hierarchical level we know by definition (as of Annex 1) that in addition to all material and energy interactions, inherent in their internal structure based on lower hierarchical levels (i.e. metabolism), and including consumption of plants (as level 3 entities) and self-similar animals (from level 4 entities), they also:

- Are able to move in space and time relatively to zones with different material, energy and chemical-reactive composition.
- According to their needs, can recognize the surrounding material composition and choose a suitable for their metabolism environment for existence.

We can discuss information processes also with regards to mature systems of the 5th hierarchical level of Civilizations, based both on their natural components derived at the 4th hierarchical level, and on their artificial specialized components provisionally designated as a (4+) level. For the levels below 4, for example some plants, we can also identify information processes, but after an in-depth analysis what we find is rather an energy-matter based simple feedback of metabolism. Many plants follow the movement of the sun on the principle of maximizing the internal processes of photosynthesis; more advanced species of the so-called predator (carnivorous) plants which eat insects, appear rather as a transitional type towards the animals on the 4th level. Bertalanffy evaluates the information capacity of the DNA as [20 EXP 1 000 000] (20 amino acids in millionth repetitions of length, of the combination DNA), which far exceeds the estimated number of objects in the Universe. So, the birth of the living cell cannot be interpreted as a pure Brown mode stochastic movement of chemical compositions. But it is information encoded in life's reproductive technology, rather than in the continuous (!) interaction between the environment and the living cell.

A rejection of the above boundary (as of prerequisites ##02A) that we have placed on the frame of information processes, would extend the concept of information interaction to the level of anyone else of the material-energy physical interaction in the known Universe, which will erase the difference between the concepts of Matter and Information (i.e. will nullify Wiener's differentiation).

The localization of the information process within a multilevel hierarchic Universe only in instances of the 4th (and higher) hierarchical level allows the formulation of a concrete pragmatic definition of the information concept as follows:

0 - 2B (working definition)

Information = Image/representation *of the structure of the surrounding world in the subject's own structure* (instance of the hierarchical 4th level), in the context of its General Existence Function (GEF) and the necessary non-random processes of interaction with the environment determined by those GEF.

> Here an explicit provision shall be made: when talking about image/representation, it is not only the optical spectra of sensing which is accounted, but any media space sensor types and their output inside the Subject' material structure

This definition closely correlates to one given in [Markov et al, 2007].

The definition specified in this way has several key aspects:

• **Images/representations of the structure** of the outside world (for natural systems) are:

1. *Made by received signals from the outside world.* Signals as a state of the structural multi-level universe - are the result of the standard motion of matter at lower hierarchical levels, and those signals are perceived/ recognized by entities/instances of higher (material) hierarchical levels;

2. *Retained by specific reordering/coding of the signal in the internal structures of the subject entity* (introduction of the concept of **Memory** as a subcomponent of a system of 4th level / animal class);

3. *Made by specialized component* - the principle of functional separation of internal components/organs and transformations of the base of the subject's pyramid of values (introduction of the concept of the ***Observer*** as a sub-system/component of the hierarchical 4th level / animal class).

• **Key features of the image o**f the universe are:

4. *The image of the universe is not a part of the genetic code of reproduction*. It is acquired during the life of the subject. The genetic code determines only the set of sensors (as components), the sensitivity and possibly - their evolution, construction, maturity and time of effective life;

5. *The image of the world depends on the set of specialized sensors* (of the subject / animal) .For our Earth these are: optical-visual, acoustic-sound, gas and chemical based. Very rarely - geo-magnetic, gravity or thermal sensors could be observed. There are no observations of proton-neutron sensors, or X-rays or gamma-rays sensors (of such type of radiation) in studying animals;

6. *The Image is stored inside the subject entity*, using a special optimized scheme of information compression and there is a pragmatic policy of keeping important parts of the current image and policy of "dropping" obsolete parts;

> Basically the volume of image information throughout the life of an entity, passed through its sensors, exceeds many thousands times the volume/capacity of its specialized memory. Information compression of images is most easily done in memorizing the structure of the surrounding world, and, for the very low-level entities - in memorizing all sensed recurrent instances.

7. *The image of world' structure* is used in the production of a "policy" behavior against the environment for any entity of the 4th (and higher) hierarchical structural level. This raises once again the imperative requirement to assume the subject's structure of corresponding complexity, in the context of cybernetic concept for the application of Information as of [Mazur,1970].

0 - 2C (framing)

The localization of the information process within the boundaries of a multilevel hierarchic Universe solely for the entities on the 4th (and higher) hierarchical level, which are finite objects, would render this process as a finite one, once limited in time within the period of existence of such material entities, and a second time - limited by the entropic metrics capacity of the entity, receiving the information.

By itself, the information type interaction between two entities is conditional – the actual information entity theoretically interacts not with a single information object of various other levels, but always with a huge number of other entities, forming the Universe around it. If we apply the formalism/notation of the Mathematical theory of systems in the matrix form to the following expression:

$$[A]*[X] + [B]*[Y] = [0] \quad (1)$$

Where:

[X] - vector of the Subject's states - a finite implementation of the 4th hierarchical type/level or similar artificial equivalent;

[Y] - vector of external factors - from virtually infinite multiple objects in the Universe;

[A] - matrix describing the internal structure of the Subject;

[B] – vector describing the external interface of the Subject

then, in order to compile [B] we will have a problem - how is the infinite vector [Y] to be transformed into finite [B]*[Y].

The above approach is consistent with the Skolem's paradox [Skolem,1922], approving admissible enumeration based on a finite set (projection) as part of an infinite one (as of [Penchev, 2011]).

And here we can introduce the concept/role of the ***Observer*** as a functional subsystem (of any structure from the 4th hierarchic level) of entity-subject in the process, which aims at reducing the practically infinite set of surrounding objects-entities, ready to interact, with a finite set, adequate to the own subject/entity' s complex structure. The *Observer* (as a finite subsystem) as a quantitative information filter, acts as a factor determining the capacity of the communication channel in the paradigm of communication information entropy metrics (of [Shannon,1949]) and limits the information interaction of real subjects-entities with the outside world and those of its own kind. The *Observer* is always functionally related to the surrounding objective Nature/Universe - either in terms of movement in space

or as a factor of material metabolism or energy exchange with the outside world, depending on its General Existence Function (GEF).

0 - 2D (corollaries)

Determining the nature of entities of hierarchical level 4 as such who participate in the information process with the outside world and the refinement of p.4 from (## 02B) – i.e. the absence of information about the surrounding structure of the Universe at the genetically-reproductive level (of internal complexity growth & exchange) of these level 4 entities, positions the latter in a specific class of information-gathering and information-seeking systems. This is what determines their specific behavior and their properties in realization of their GEF (which properties we will formulate later in explicit manner).

The formalization of the concept of information, based on its direct relationship only with structural entities of the 4th and higher hierarchical level, and the implication of the relationship with their main function of existence (GEF), determines the MANDATORY semantic and pragmatic nature of the Information's phenomenon in natural systems of such level, which will be investigated further. And really - how to link the property of "information-seeking" with a case of "no meaning in the perceived signal" or "lack of application of the perceived signal"? This virtual conflict reinforces the above binding semantic and pragmatic aspects of information in the natural material systems, starting from certain hierarchical level up, and in particular - including the problem of formalization of the "mentality" of Homo sapiens.

In semiotics, *semantics represents relations of signs to the objects to* which the signs are applicable, i.e. to their *denotata* – as of [Burgin, 2010]. Projecting this common definition against definition in ##02B of semantics produces the concept of image of the structure, as signs assigned to the objective phenomena, but in a compressed (!) and optimized manner.

> Here the meaning of information compression and optimization results in assigning the same signs to the same (relative to the *Observer*) objects or phenomena that binds the sign specifically to the structure of the object (the "concept"), rather than its multiple implementations/instances.

Even, when postulating entropy metrics in communication information theory [Shannon, 1949], Weaver sets the so called "*semantic problem*"- "How precisely do the transmitted symbols retain the meaning that the sender intended?". In fact, Weaver makes a mistake, but not so much in the description of the phenomenon, than in determining its boundaries/framework. The communication information theory is indifferent to the nature of the sender and the recipient. However, when we analyze the phenomenon in

our paradigm of the information process between sender/Universe and recipient/*Observer*, the problem quickly finds its own solution: when the sender loads semantic meaning – this could be done in the context of the covering/containing super-system only. And only in this super system's (finite) paradigm we may have a receiver interpreting properly the sent meaning. In a super-system paradigm, the communicating entities are *components*, governed by the same super-system's General Existence Function (GEF), and use common sets of meanings (of the signals). For all other cases, meaning will remain the receiver's interpretation only! And the sender's meaning (if any) will diverge from the receiver one (as of Theorem 4 later) in an asymptotic manner.

"Pragmatic aspects of information are embedded into the situational context of the system that receives, produces, sends or finds information" [Burgin, 2010]. This concept correlates very well with the engagement of information with the *Observer's GEF* - entity and his local semantic context.

The pragmatic aspect of information is rather ignored or remains outside the paradigm of current information theory. Historically, the pragmatic aspect of information is related to economic applications of information inside the entrails of Civilization (at the 5th hierarchical system level) and first identified in [Marschak, 1954]. Even then, it is noticed that the local metrics of Pragmatic information differ from that of communicating information. The "economic" view of the phenomenon establishes "that Shannon's entropy *H(X)* is an important measure of information, which clearly does not depend on the particular uses to which the information will be put. However, the user is more interested in how much a portion of the information is worth for her/him and how much she/he is willing to pay for this portion of information". This confirms the global paradigm proposed here – a framework of semantic and pragmatic information as a material phenomenon of the Universe, and also the locality of pragmatic information metrics which is directly tied to the *Observer*- recipient, and too weakly to the hypothetic sender-source.

1 History of the creation of the semantic and pragmatic information paradigm (Evolution of semantic models)

Initially, a semantic theory of information was created by Katz and Fodor from MIT [Katz & Fodor, 1963], but its development was strongly associated with natural language, an explicit caveat of its creators. The main focus there is on the possibility of structuring natural language, its relation to the possible presentation of meaning and the characteristics of ambiguity in natural language (in terms of synonyms and homonyms) and the special conditions for eligibility and non-eligibility (non-sense) of combinations of language units, grammar and syntax, which, even when placed in a proper formal structure, prevent the possibility of composite meaning. This theoretical framework is rather necessary than sufficient for

solving the problem, as it provides an exhaustive "literary" description of the phenomenon, but not the necessary details for the construction of a new, upgraded alternative conceptual framework to hold both natural and formal artificial semantic codes.

This theory includes:

(A01) - Glossary of terms (in the given language)

($D = \{d_j, j = 1\text{-}N\}$, where D – glossary set of N elements, d_j – j^{th} term of the set);

(A02) - Hierarchical semantic chains and sets of terms

($E_x = \Sigma\, x(d_j)$, where E –semantic Herarchy, $x(d_j)$ – semantic relationship of term d_j for coding a complex meaning out of linguistic atoms and their relationship in a hierarchical pyramid of complex, composite meaning);

(A03) - Rules - grammar and syntax, with which these terms construct a description of the entities or describe relationships - sentences or judgments/thoughts

($R=\{G,S\}$, $G = \{g_i, i = 1\text{-}K\}$, $S = \{s_{ij}\}$,

where G – grammar set of K rules, g_i – grammar rule, S - sintax set , s_{ij} - syntax rule for g_i application);

(A04) - Function of meaningfulness (F^{**}) for each possible combination of terms (or semantic hierarchy) and applicable rules, which constructs a "reason space" (a triplet $\{E_x, R, F^{**}\}$ with instances of $E_{xy} = \{(E_x(d_j)) \,|(g_i,s_j), F_{xy}=1\}$) which filters meaningful (eligible) judgments from meaningless (ineligible) ones, in or outside the context of other previous/subsequent judgments (and the basic pragmatic value/utility of the output atomic terms under this model). This function of meaningfulness differentiates/identifies the hierarchical construction of a "sentence" out of a simple "word salad";

(A05) - Multitude of eligible meanings (E_{xy}-i, E_{xy}-j …), expressed in a given sentence (in particular – a single one in an unambiguous (i-th or j-th) language coding sense, and several meanings in context-dependent use of the sentence).

The sufficiently large vocabulary (based on the analysis of English in the mid-20th century) and the quite diverse set of rules result in a very large (exponential, practically infinite) set of possible sentences (on large set of terms), respectively in a explosively larger and practically non-analyzable space of theoretically possible meanings constituted by a current natural language (E_{xy}-i, E_{xy}-j, …, (y= 1 - ∞)). This space accounts for the generally methodological and very limited practical use of this Theory (i.e. in its natural language based approach). Later, this theory was laterally developed towards elaboration and determination of the Syntactic theory (of information), developed in its core principles by N. Chomsky of MIT [Chomsky,1965].

Some time before that, in the early 50s, I. Bar-Hillel and R. Carnap, [Bar-Hillel & Carnap, 1953] building upon the earlier theory of inductive probability developed by Carnap, outlined a framework and basic rules for the so-called "semantic" information: a common measurement of entropy metrics and rules for compounding information amounts for independent/orthogonal objects/features. Definitions have been proposed for measurement of "content", "information", "estimation" in a limited language (!) set. A more careful analysis will show that all three aspects are practically a tautology of a single understanding of information (based on entropy). As in the work of Katz & Fodor, what is considered here is an abstract one-dimensional case of analysis in a closed system. Consequently, the resulting "one-dimensional" theory falls within the limits of the theorem of K. Gödel of incompleteness [Gödel, 1931].

The work of the Bar-Hillel and Carnap shows another weakness, which is of crucial importance for the further development of a genuine semantic "meaningfull" information theory (and not simply termed "semantic" information). It concerns the term "assessment"/estimation and a need to replace the term with "self-assessment". Because when we talk about evaluation of phenomena, we must recognize the participation of the so-called external *Observer* - evaluator, which must be external to the observable phenomenon, system / network / metrics, and must be added to the analysis of the information complement (practically the so-called Gödel complement) associated with this *Observer* appraiser, as well as the information loss from (Shannon's) "channel digression" between *Observer* - evaluator and the assessed subject. The system of Bar-Hillel & Carnap will retain its internal consistency if and only if we deploy "self-assessment" and not (practically the broader, external) independent "assessment".

In this context, we can delineate the Evolution of semantic non-linguistic models as follows:

- The Bar Hillel-Carnap framework practically covers clause (A1) in the model of Katz-Fodor, but appears indifferent / neutral / capacity-less in relation to model requirements (A2), (A3), (A4), (A5).
- The increase in the consumption of machine-readable information stimulates the introduction of an abstract semantic model "Entity-relationship", formalized by P.Chen [Chen, 1975]. This model covers clause (A2) of Katz-Fodor model, and now we can consider separately the entropy metrics of the images of entities and the entropy metrics of the relationships, which in aggregate increase the total measurable information in the paradigm of entities and relationships.
- The Syntactic theory developed (at this time) by N. Chomsky complements structurally clause (A3) of the Katz-Fodor model. At the same time, the lack of effective formalism in clauses (A4) and (A5) leaves us at the level of a "salad of words" (to use a term from clinical psychiatry), and too far from the goal of a general semantic theory, at least at the level of natural language.

Newer studies and attempts at structuring of the semantic information in different directions contribute to a scholastic approach in such structuring. A perfect example of this is the frame used in [Floridi, 2003]; [Floridi, 2009]. In addition to this strict (philosophy level) approach there are still different eclectics of combined (both simultaneously material-objectivist and ideal-mentalist) paradigms (such as [Burgin, 2011]) which makes no sense to be considered here. Floridi's semantic concept of information is "well-formed, meaningful, and truthful data". A similar definition of semantic paradigm is proposed in [Hu & Feng, 2006] and in many other works of authors from the actual "philosophy school" on semantics. A good summary of these approaches is provided in the comprehensive work of [Dodig & Hofkirchner, 2011].

As an illustration of that concept we can suggest an examination of Homer's Iliad as an ideal Floridi-style representative of the Semantic information in a closed system.

T.Adriaan [Adriaan, 2010] criticizes this assumption, and explicitly emphasizes the absurdity of assuming the existence of a monolithic concept of static information, regardless of any external *Observer*. Careful reading of this definition shows 3 (practically orthogonal) components that cannot be evaluated/assessed in a mutually dependant manner. Each of these 3 components falls within the scope of Gödel's incompleteness and as such - remains unverifiable inside the framework. Here we are talking about ideal semantic theory in a closed (non-arithmetic!!!) system, in contradiction to Gödel's theorem of incompleteness. In addition, Floridi do not comment on how such a closed system is physically possible.

Regarding Floridi's theory (in the context of Gödel incompleteness), there may be offered a "heretical" counter-proof of the following type:

- For each data element can be offered such Gödel's complement, according to which this element will be well structured and another one that will render it "ill-structured";
- For each data element can be offered such Gödel's complement, according to which this element carries some meaning/content, and another one for which the data element has no content – i.e. becoming "white noise";
- For each data element can be offered such Gödel's complement, according to which this element is "true" and another one where it becomes "false"/lie.

This counter-proof expands the definition of Floridi within the volume of the entire Universe, making such framing/definition meaningless as a form of restriction.

There also exists another counter-proof of Floridi's definition, based on the second component – regarding the objectification of information and the possession of significance. If we consider the system of the *Observer* and Source in the information process, and we replace the Source with the whole Universe (which is methodologically permissible), then for each signal received by the *Observer*, we can find adequate real (energy-based or material) process in the Universe, i.e. EACH information/data element (signal) can have a non-zero real significance/meaning. In fact, the so considered system implementation remains "opened" for the *Observer* (which is always a finite entity with a finite system's capacity) and consequently the requirement for proper definition and authenticity remains unattainable, since B3.3 and B3.4 from the definition below in (##2) become exponentially complex with respect to the size of the possible range of signals, and the Universe generates infinitely more signals. In fact, the system implementation considered in this way is semantically OPEN to the *Observer* (as a finite system with finite capacity) and consequently the requirement for "well-formed" and "truthful" remains unachievable – the Universe generates infinite multiple signals. There:

- Infinity cannot be divided into right and wrong formed/defined;
- Infinity cannot be divided into true and not true.

The above inability can be overcome partially by the Skolem paradox [Skolem, 1922] about an admissible enumerated part of infinity. There we can talk about enumerated "well formed" and truthful part of a finite subject in respect to infinite objects, from there – about a local Relativity of Floridi's paradigm, and respectively a possible partial (!) applicability of the approach.

The above discussion leads us to the singular corollary that according to Floridi's paradigm, our *Observer* cannot receive semantic information from the surrounding Universe (philosophy's incognizability ??!)

On the other hand, using the definition of C. Morris [Morris,1938], W. Hofkirchner [Hofkirchner, 2012] namely that *semantics is the connection between the sign and the Object* (!!!) external to the entity in the system of [Floridi, 2009] we are directed towards a search for another, expanded paradigm, that could actually help to achieve a Unified theory of information, one that is structurally integrated in what is defined as the basic theory of classical physical communication of Shannon & Weaver [Shannon,1949]. Indeed, this goes beyond the actual scholastic philosophical approach, but provides new opportunities and significant practical results. In addition to the cybernetic information theory [Mazur, 1970] describing internal system processes, in a finite subject with non-minor, substantial structural hierarchy, such new theoretical framework will give further application to the semantic information paradigm in the design of complex self-organizing and self-building (autopoietic) systems.

2 Definition of viable frames for a semantic information paradigm

Establishing such a paradigm implies fixing of few key definitions for the presence, absence and quality of semantically significant information process:

2 - A1. We can speak about information signal with zero meaning: (lower border of the proposed framework):

- if and only if there is a closed system with an *Observer* and a virtual, intangible source that generates random signals (with random distribution of "white noise" type);
- in case of an *Observer* with wrongly functioning sensors / missing sensors.

2 - A2. Information signal with *correct non-zero meaning* can exist when:

- the Sensors of the *Observer* has received/identified an external signal;
- the template Database of the *Observer* has the appropriate template for the received signal (a special case of identification);
- the Filter / recognition component has discerned the data received from the sensors.

2 - A3- information signal with the *wrong meaning*: can be considered solely in the context of a malfunction (!) of the components of B1, B2, B3 of the *Observer* (see further concept definition below), i.e:

- an *Observer*'s sensor is acting improperly and without justification had generated an appropriate signal – non-systematic, random distortion of the channel;
- The *Observer*'s database with templates does not possess the appropriate template (and thus the semantic chain included in this template); it does not match the reality – a trivial case in which the capacity (in Kolmogorov's complexity entropy) of the *Observer*, a finite real system (from the 3rd to the 5th level of the structured hierarchy), is always infinitely smaller than the capacity of the Source, i.e. the Universe's capacity;
- The filter/recognition component has carried out improperly the discrimination of the data received from the sensors - this is non-systematic random channel or Receiver distortion, or insufficient capacity of the recognition procedures in the templates' database.

In a specific context (systems positioned above the 4th hierarchical level), the appropriate zero semantic information can be interpreted as such non-zero one of the information system's status - either due to (trivial) insufficient capacity of the *Observer*, or as a signal on subject/ *Observer* malfunction.

Based on the foregoing counter-proof of Floridi's paradigm, we can offer an alternative (mirroring) paradigm of semantic information, namely:

2 - B0: For information (resulting from a process) we can talk in a system of at least two components: an external power/source and a Recipient. In general, the external power/source can be the Universe, but it may be any another separate entity. The third component in the system can be the "channel" - broker between the two components, for which the theorem of Shannon- Hartley- Weaver applies.

> *The term "Recipient" (same as the "subject" in the paradigm) requires some deciphering and cannot be seen as collective noun of a "philosophical" nature. Here "recipient" covers the complex structure of 3 different components: sensors, memory models / templates, and filtration /recognition processing subsystem, with its minimum complexity (!!!) structure. This means: sensors for at least one physical parameter; a template threshold value for this particular parameter value; and a filter discriminator of such value. During physical implementation, these three components could be combined into a single physicochemical process (at least for entities under the 3rd hierarchical structural level of the classification of the Universe's material objects as of Annex 1)*

2 - B0-1: the conversion of the function of the sensor $\Psi S(i,Z)$ (the transformation of i-th sensor for signal Z), or item element from matrix B from equation (1) will play the filtering role for the countless signs in the Universe, forming a finite set (with limited entropy) of signals for internal processing by the *Observer*, i.e.

$$H(\Psi S(i,Univers)) = N << \infty\ ,\ N>0 \qquad (2)$$

(When the source is undetermined, and the acceptable source becomes the Universe itself, then the structural analysis of the source signal becomes useless, since this signal represents an infinite number of elementary signals from all elementary structures existing in the Universe, and cannot be interpreted entirely by the finite structure of the Observer, regardless of its size.)

2 - B1: A structure (and its maximum entropy dimension) of a semantic information element depends on the capacity of the receiving *Observer* – in the context of the structural complexity of the Kolmogorov function (its E_x, E_{xy}(E_x, F_{xy}) of A02, A04 statements in the Katz-Fodor paradigm), as interpreted within the recipient's information entropy metrics [Adriaans 2010].

(Here, the term "well-formed" information- element object within the meaning of Fioridi paradigm needs to be understood as an information structure able to "fit" within the structures of the *Observer*. In practice, any information structure with excess capacity which outperforms the *Observer* complex capacity will be "malformed" partially, respectively with false /wrong meaning).

2 – B2: The content and importance of (semantically) interpreted information about a signal is determined solely by the matrix samples/templates of the subject E_x (see A2 in Kats-Fodor concept).The interpretation is only locally justified.

2 - B2-1: In general, the same signal may have different meanings for two different Observers, and the same signal can be generated by different sources, respectively with different semantic loads (polymorphism);

2 - B2-2: For an *Observer* who has no corresponding sample/template for a given signal, the appropriate event is interpreted as *white noise* and bears no information; the importance of values is zero

2 – B3: The "authenticity" function (true-false) of a detected data signal is determined by the capacity of the filter/ recognition system of the *Observer*. As a general rule, this involves four aspects:

2 – B3-1: Reliability of the *Observer'* sensors;

2 – B3-2: Sufficiency of the capacity of the *Observer* to accept the whole signal;

(White noise can be interpreted as improper semantic information due to the limited capacity of the Observer in B1)

2 – B3-3: Sufficient capacity of the integration Filter/recognition system and database/ patterns memory, including "second order" patterns: verification of combinations of elementary signals, detected by simple "first order" templates and identification of the "context" in hierarchies of higher-order signals (i.e. a limited set of templates of hierarchical combinations with non-zero natural importance/ usefulness for the *Observer*);

(Generally, the recognition of the same signal and even a semantic meaning that is identically recognized by two Observers may yield different values under the "authenticity" function. A trivial example is a person who trusts his eyes rather than his ears: hearing a "hissing" sound entails a snake (real hazard), but seeing a "hissing neighbor in the town" still implies safety (false hazard).)

2 – B3-4: Complex stability/consistency of the integration filter of the *Observer* for explicit identification of the useful signals/information.

Here, both sets of templates and functions of authenticity come into resonance with the structural capacity of the subject, expressed in entropy metrics, compared with the entropy metrics on the signal:

• In general applications, the signal is with a lower entropy value than the entropy of the complexity of the subject/ Observer;

• When a signal's entropy value is greater than the complexity of the subject, then his filter of authenticity cannot determine unequivocally the truth, and must apply the rule of Complement, that can be either optimistic (new unknown item is true) or conservative (new item is false, misleading, noise)

The paradigm presented in this way is structurally compatible with the paradigm of quantitative information of communication of Shannon, Weaver, and with its use we can structure in a uniform way the semantic-pragmatic components, hitherto placed under the collective terms of "consciousness" and "reason".

3 Formal presentation of the infrastructure of a subject with pragmatic information

To simplify the presentation below, we will further formalize the subject – *Observer* of information as a system of the type:

$$
\begin{aligned}
SX_i := \\
&\{\ SS_i = U\ ss_{ij} \\
&MS_i = U_i[\cap_{ij}\ ms_{ijk}] \\
&FS_i/MS_{ij} = U_i[\cap_{ijl}\ fs_{il}/\ ms_{ijk}] \\
&\Delta_i(FS_i/MS_{ij}) = U_i[\ \delta ij(fs_i/ms_{ij})]\ \}
\end{aligned}
\tag{3}
$$

Where:

SX_i - inventory of i- th semantic *Observer* – subject;

SS_i - array of sensors/ sources of information for the i-th Entity with dimension of j= $1,M_i$;

MS_i - database (union on j) with supporting templates/samples of data elements and their semantic network (conjunction of k elements) for the i-th semantic *Observer* - subject with dimensionality of i*j;

FS_i/MS_{ij} – database (union on j) with supporting templates/samples in conjunction with set of filtering rules and their combinations for l=1,Lj (a rule for both patterns and combinations of patterns) for the i-th semantic Observer-subject;

Δ_i - matrix of values of the utility function for each element of FS_i/MS_{ij}

MS_i here plays role of specific language for semantic communication and FS_i/MS_{ij} - of "knowledge pyramid" coded by this language.

$$\Delta_i = \Delta_{i\alpha} \cup \Delta_{i\beta} \cup \Delta_{i\lambda} \tag{3A}$$

Where:

$\Delta_{i\alpha}$ -- unconditional inherited utility matrix;

$\Delta_{i\beta}$ -- Acquired (restructured and stabilized as of B3.4.) utility matrix;

$\Delta_{i\lambda}$ -- Acquired unstable matrix of potential (!!!) utility of rules for signal processing, which currently are not useful, but may in the future benefit substantial usefulness.

In the above specified formalism we can introduce a special metrics for the semantic information CAPACITY **Co(i)** of the *Observer* (i) as an integral Entropy (H) of all (registered inside images of) entities and their relationships' permutation, scalar multiplied by "actuality": function Ω where:

|Ω| = 0 when there isn't a valid rule accepting relationship in the database FS_i/MS_{ij}

|Ω| = 1 when there is present a rule accepting relationship, for which a non-zero utility function is present too, i.e.:

$$Co(i) = [H(MS_i, FS_i/MS_{ij}) * \Omega \{(FS_i/MS_{ij})/ \Delta i(FS_i/MS_{ij}) > nill\}] \quad (4)$$

The so-configured entropy metrics for semantic information is substantially lower than the one of the Bar Hillel-Karnap approach for entropy metrics of content (even in accounting only for the entropy of the real items from MS_i). This hyper-extensive power of the Bar Hillel-Karnap approach arises because of the content's entropy of full permutation of the set's components – entities and relationships, and not only of the admissible ones.

The above presented formalism of the *Observer* allows formal presentation and analysis of any semantic information process, and compilation of a set of properties and rules of tremendous practical importance for the future development of information technologies. This formalism allows for a substantial informal interpretation of both philosophical and advanced scientific aspects.

The moment of creation of this theoretical approach coincides with the development and use (for more than five decades) of simplified artificial languages for interaction with the computer systems developed at that time - successors of the abstract elementary Turing machine and their final formal grammar and syntax, which guarantee a limited finite set of terms, a finite set of relationships and transformations, and respectively a terminal fixed multidimensional matrix of possible meanings. Developed during the same time, the theory of structuring large datasets has established the paradigm of "entity-relationship" (ER) ([Chen,1975]*,* [Brown,1975]) *as the main building block for hierarchical designs of complex sets of related terms, transformed by the standard rules of formal computer languages, and later also the so called "object-oriented" approach for construction of complex semantic structures in a hierarchy of simple components, by applying special rules to ensure the function of meaningfulness of the components downstream. Here, the purposefully declared union of simple sentences /phrases in a complex hierarchy may be defined as "theory", which is not related to a specific linguistic term or atom, but is posed as a "category" – a set with non-zero semantic load greater than the flat intrinsic value of the sum of its individual terms.*

The experience gained so far with rules for establishing (computerized – i.e. formalized) semantics, allows us to expand the framework of semantic information theory beyond the notion of elementary language capacity as a means. Now we can add abstract sets of hierarchies of relations "entity-relationship" established between the basic significant terms of the dictionary, other similar terms, or objectified structures of entity-relationships with positive functioning of eligibility / pragmatic utility (by default - all objectified expressions suggest a positive function of the physical/meaningful eligibility and especially of the utility score in the system). Here we are no longer talking about simple (formal) language of expression of a relationships set, but rather about a system for coding and expression of "knowledge" as inverted (!!!) hyper- pyramid (by analogy with multidimensional hyper-cube) of simpler or more complex formal-scientific (locally-correct) theories, which at some point integrate, complement, and mutually determine (!) each other, producing valid pragmatic/ valuable semantics for the Civilization system. The more we observe the temporal course of such information-retrieving and self-developing system - subject, the higher complexity accumulates in an exponentially growing volume (as of Kolmogorov complexity) for this subject, and from there - it acquires increased capacity for absorption of more new OTHER (previously unrecognized) signals from the surrounding universe. Hence, a random growth (as Brown movement analogy) transforms into purposeful "autopoietic" information-seeking *entity.*

4 Theoretical apparatus of a semantic-pragmatic information paradigm: rules and properties

Based on the above formal definition of the subject in information process and the counter-proof of Floridi's concept, a few key statements below, describing the properties of the new alternative paradigm, could be considered to be correct:

Lemma 1:

In the real world, the concept of Semantic information (in an arbitrary schema with *Observer*) at the Subject site possesses quantitative aspects and entropy metrics (as of [Bar-Hillel & Carnap,1953]), identical to communication information metrics (as of [Shannon,1949])

The proof of the above assumption can be found in the definition framework of the process and its finite material basis – the structure of *Observer* within the Subject.

We can speak of limited semantic information only in closed spaces and private information systems, with limited finite Observers

Lemma 2:

In the real world, the category of ‘‘truth" (truth / false) and the category of "correctness" (well formed / malformed) with respect to semantic information can be associated only with the incompleteness of:

- the received/identified signal due to communication (and sensory) causes;

- the *Observer's* database of interpreting templates,(memory for templates) in which the complex capacity of the Observer is always less than the one of the Universe, expressed by entropy metrics as follows:

$$\text{Cuniverse}(NN) > \text{Cuniverse}(\sum(C_i)) > \text{Cuniverse}(Yh). \quad (5)$$

Yh – Observer, Cuniverse(*Yh*) - observer's entropy (as of Kolmogorov' internal complexity entropy);

NN- Universe, Cuniverse(*NN)* - entropy of all signals in the Universe (Kolmogorov's complexity of Universe);

C_i- local signals entropy, i - i-th signal received by the Observer;

Lema 2 can be interpreted as a version of Gödel's incompleteness in the context of the semantic paradigm.

Corollary to Lemma 2 (L2): In the real world (structural systems of higher hierarchical levels), differential entropy (Cuniverse - C_i) corresponds to the missing parts in the database of interpreting templates (i.e. inadequate capacity of the *Observer* according to statements A02, A05).

Hence:

$$\textbf{lim}\ Dkl(C_{universe}; C_i) \to \infty \quad (5a)$$

(where the missing templates' set can be measured with Kullback-Liebler divergence Dkl(Cuniverse; Ci))

The above corollary corresponds to the principles of building GEF of systems (of the 4th and higher hierarchical level of structural complexity), where one should take into account the finite nature of this system and the practically infinite information flow from outside.

Corollary L2 may be accepted as unambiguous solution of the Second philosophical question of cognition, the answer is - "practically incognized/ unknowable in entirety" (i.e. impossible holistic approach!). Cognition in entirety can be reached only in the infinity of time and space by infinite structure - subject

Theorem 1: (creation boundaries)

In order to establish a sustainable Observer in an open/real information environment, its set MSi should possess a couple of "boundary" components: one that is a "substitute for infinity", and another one that is a "substitute for zero", where

- "substitute for infinity" complements semantic chains for which no rule of a sustainable relationship with existing finite entities' images can be constructed despite the pattern requirement;
- "substitute for zero" complements semantic chains with no entities' images /missing images, or White noise denotata.

The above theorem represents a paraphrase of Gödel's complement, placed in the information paradigm of real physical systems. Only with a "substitute for infinity " one can build a closed system that allows implementation of the B3-4 definition statement – that is, the matrix with templates for sustainable existence that functions as a template for the Universe and its constant variance /expansion in the context of an incomplete internal (to the *Observer*) paradigm. In this sense, Gödel's complement is the default component for working out unstructured or incorrect input, which procures semantic stabilization for the *Observer*'s internal system {templates and semantic chains}. In the same manner we need a "substitute for zero" as of initial state of the *Observer'* memory items.

Lema 3:

In the real world, the concept of Pragmatic information is strictly linked and limited to the Observer's information system, for which "importance" and "truth" have non-zero value only within the scope of its own semantic network MS_i , and for which usefulness there are identified non-zero values in Δ_i (and finally both sets are linked with structural GEF $\Phi(j)$).

> *Regarding the above statement, the scholastic interpretation of "pragmatic information in general" (in the context of the definition of semantics in* [Floridi, 2003], *and respectively of a "virtual absolute sense" of the hypothetic higher level structure should not be sought in terms of the surrounding Universe. The pragmatic information is always linked with specific entity instance and its real Observer component structure*

Corollary A to Lemma 3 (L3A): In the real world, material systems of different hierarchical levels (both natural and artificial, which are part of the natural ones) have different requirements for the minimum volume of active sensors and the minimum volume of basic templates /samples, minimum volume of usefulness of entities depending on the conditions of their existence – the environment and the level of (their own) hierarchical structural complexity (and corresponding GEF).

A good example of sensorial capacity, specialization and complexity are the primitive sensors of cnidarians' organisms and the significantly more complex, sensitive and powerful sensors of mammals on Earth.

Corollary B to Lemma 3 (L3B): In natural systems's *Observers*, there are always present or arising so-called Category–templates concepts, which act as "partial replacement of infinity" with near-zero value of pragmatism/usefulness in a particular thematic area. In general, each new concept (new record in MS_i) can be regarded as a semi-Category concept, keeping in mind the possibility that in the future each *Observer* shall encounter conditions for refining, respectively restructuring and detailing the so-named thematic and re-weighting of its non-zero utility.

Based on the observations of Homo Sapiens and the concept of the origin of language as structured patterns and relationships (as of [Bertalanffy,1969] *) it is considered that language and thought, or expressions and thinking within the wide range of associations (templates), precede the differentiations of meanings (relationships) within articulated speech (*[Werner,1957] *). Similarly, the notion of a developed conscious life, as the differentiation of the "I" from the external objects, and also of space, time, numbers / counting, causation, and so on, have evolved from the sensory-conceptual motivational continuum we associate with "paleologic" perception (of the outside world) by infants, primitives and schizophrenics* ([Arieti, 1959], [Piaget,1959], [Werner,1957]*). Thus the "I" and the "World", "consciousness" and "matter", or Descartes' "res cogitans" and "res extensa" are not just standard templates and primordial sets of antitheses. They are the end result of a long process in the mental development of the child and the cultural and linguistic history of society, where the perceiver is not simply a receptor of stimuli, but in a very real sense, creates his/her own world (e.g.* [Bruner,1958]*;* [Cantril,1962]*;* [Geertz,1962]; [Matson ,1964]) *and respectively its individual matrix of patterns and relationships.*

This state can be interpreted as the equivalent to the existing relativity theory in physics, as the General Theory of Semantic relativity"(!) whereby for each Observer and his private semantic capacity, the current semantic value of discriminated information signal will not possess in time always the same constant value.

Theorem 2: (on combined information semantic aspect and pragmaticity)

Subject's own semantic infrastructure – the database of templates (models and semantic network) of an instance – *Observer* (of the 4th and higher level) is always associated with a pragmatic infrastructure –

the Pragmatic non-zero weight of the described elements, projected on the objective GEF of the entity / individual, and/or (when available !) on the hosting hierarchical complex instance GEF.

This statement applies to all natural systems. The proof lies in the "teleonomics" of such structures and the practical impossibility of material structures (apart from some *advance* players on the 5th hierarchical level and its artificial components) to create a practically unlimited capacity for information templates (with respect to the outside world) for such events and phenomena with no direct (pragmatic) connection to their Basic GEF. It should be noted that any material system spends some minimal internal energy in building up (*autopoiesis*) a proper information capacity for templates, including also this unnecessary local information capacity for templates with zero pragmatic value, emerging in the lifetime of open self-improving structures. In this context, the existence of minimum capacity templates with zero and "close to zero" pragmatic value emerges in (open natural) hierarchical systems of the 4th level (animals) as a storage place for information about a territory, which may or may not become permanent habitat. Overloading the information capacity via such unnecessary information logically reduces the processing speed for information with key pragmatic value and from there leads to decline in the survival time of the individual within a general aggressive environment.

> *In advanced hierarchical structures, where the elements are partially or entirely artificial (i.e. their existence is a function of the architecture of the implementation of a higher hierarchical level), it is possible to observe extended information capacity, significantly exceeding the minimum requirements under Corollary L3A. Examples of this are the autonomous brain in animals, and the overall development of the Homo genus in the early stages of civilization, the modern computer systems in today's civilization, etc …*

Lemma 4: (on restrictions of the semantic capacity)

Any *Observer* of pragmatic information has a limited capacity $\mathbf{Co}_i$, which is a not greater than his/her $\mathbf{SX}_i$ (as structural entropy).

In this context Co_i (entropy metrics for Kolmogorov structural complexity) plays a role in limiting the capacity of a data channel with respect to the entropy H of the outside world and according to the theorem of Shannon-Weaver (applied in a modified scheme) the Observer is limited in accepting information from the outside world.

> *An additional limit of the information capacity of the Observer(i) also arises from the (next) Theorem 3, due to the dependency of FS_i /MS_{ij} on the pragmatic value of each rule in the array tied to the GEF Φ_i (!!!) of the Observer (i.e. "knowledge" is bound by the terms of the physical existence of the subject).*

Lemma 5: (on semantic communication)

Exchange of semantic (hence a pragmatic) information between two separate objects which can create and consume pragmatic information (i.e. natural ones above the 4th hierarchical level or artificial components from the 5th hierarchical level) can take place without loss of meaning (i.e. without "entropy fading" of the channel) if and only if the relevant objects are absolutely identical to each other in all elements of the *Observer's* information processing structure, i.e.:

$$\begin{aligned} &\textit{For each } SX_i,\ SX_j \\ &\quad ss_{ij} = ss_{jj} \\ &\quad ms_{ijk} = ms_{jjk} \\ &\quad fs_i/ms_{ijk} = fs_j/ms_{jjk} \\ &\quad \Delta_i = \Delta_j \\ &\text{for the whole dimension of ij.} \end{aligned} \tag{6}$$

The proof of the above statement is simple. If we consider the simplest scenario, in which we have a single sensor with 2 +1 templates A,B, Nill (two meanings and a trivial Gödel incompleteness for those "other") in which one of the two patterns of the two observers are identical and the other one is different, then we have a total of 4 possible transfers of information, but only one correct interface:

A1 -> A2	**info**
B1 -> Nill2	nill
Nill1 -> Nill2	nill
B2 -> Nill1	nill

Lemma 6: (synchronization)

When Subjects cannot identify/assess the received and discriminated signal, it applies default assessment for empty signal or implied assessment for infinite universe (in T1) – either the" white noise" image, or the "infinity" image.

The above statement has the role of boundary conditions of the operating model from ## 3

Based on the above key issues (of lemmas) L4, L5, L6 we can reformulate the famous Shannon-Weaver theorem for quantitative "physical" communication' information, now in the context for the paradigm of semantic-pragmatic information:

Theorem 3: (Shannon-Weaver-Bojilov) on Limited semantic communication

Let us assume that an Observer (annimal, person or organization) (X) in a Civilization (from class Z_i , with a certain degree of development J, and pragmatic function of existence (GEF) $\Phi(Z_i, j)$ projected onto the matrix/set of utility Δ_j) has "*Knowledge*" (or total semantic capacity) Co(x) . When a separate external information source (either inside or outside Civilization) has an entropy of emission signal H, and this emission is transformed via the sensors' set with a resulting entropy of H' as of $H > H'(SS_x)$; $|H| > |H'|$, for which $H' < Co(x)$, $H'(SX_x) >$ nill; $MS_x >$ nill, then the *Observer* can receive information from this external source (with precision up to $FS / MS_j (x, J)$). When $H' > Co(x)$, there is no method to transfer data volume and accuracy higher than $Co\{FS / MS_j (x, J), \Delta_j\}$.

The above theorem on the "*saturation of the semantic-pragmatic communication*" is an extension of the rule of saturation of physical data channels. It has a fundamental application for understanding the observed phenomena of specific non-linear communication between different levels of structural development, both between individuals and civilizations, and for understanding the limits and opportunities of the more advanced structure/organism to optimize/maximize the civilization exchange of knowledge, templates, modifications in the matrix of utility Δ_j, etc.

> *At the same time on this basis we can reconstruct different practices of ABUSE of superior civilizations against less developed ones, leading to the practical destruction of the inferior ones. Such practices are observed both in history and at the contemporary level of international relations.*

The case of Lemma 5 suggests two *identical* observers, which are not prone to individual self-development, and respectively their ms_{ijk}, fs_j / ms_{jjk} do not grow, or if they do, they grow synchronously (!). This, however, does not apply to the natural case of our Civilization (of Homo Sapiens) and the preceding forms of animal populations at the 4th hierarchical level, nor to its advanced developments in the form of giant computerized information-retrieval systems and self-extending databases with significant capacity.

Corollary to Lemma 5 , Theorem 3 (L5T3): The volume of effective pragmatic semantic communication is determined by the capacity of the weakest communicator (both external information source and / or *Observer*).

> *Respectively, in the mundane case of communication of semantic important data among active people in society, the limits are set as the capability of the most unintelligent and uneducated*

person who still possesses (despite his limited capacities) citizen rights and ability to participate actively in social decision-making. This consequence has dramatic significance for the analysis of social practices at the advanced stages of civilization, which will be commented on in another paper.

Here arises the need for a formal rule that reflects the expansion processes of the Observer's (semantic and pragmatic) information capacity (i.e. Information processing self-improvement of an individual *Observer* with information capacity to be filled with information about the world around). Let us look at a formalism of simple content increase of arrays ms_{ijk}, fs_j /ms_{ijk}, Δ_j. Such expansion can be observed in two contexts:

(1) ***Initial*** (Observer's semantic infrastructure data) ***load***;

(2) ***sustainable growth*** of Subject's *"knowledge"* (as *Observer*' complex data load expansion).

Lemma 7.01 The initial state of the Observer in natural entities (of 4th hierarchical level – animals) contains no data (in MS_i, fs_j/ms_{jjk}, Δ_j).

Lemma 7.02 Initial images from sensors SSi are stored in MS_i without filtering (because no filtering templates).

Lemma 7.03 Initial relationships in MS_i are created based on statistical correlation of collected signals (discrimination of image part with higher statistical weight, generation of new sub-image *templates* and transformation of an old (raster) global image in a set of sub-images and relationship networks (with a requirement for a minimum temporal interval of the entity's life/ existence for statistical reliability)

Lemma 7.04 Initial filtering rules (i.e. "grammar" and "syntax") in fs_j /ms_{jjk}, are created on statistical correlation of secondary reaction of parental (external !) entities, or proper negative biological (internal) reaction (with a requirement for an additional temporal interval of the entity' s life/ existence for statistical reliability of the settled patterns in fs_j /ms_{jjk}).

Assessing the case of natural subjects, we must formalize the initial accumulation of information within practically just-born subjects - animals. Their genetic information determines/ fixes the availability of an

array of sensors (i.e. SS_i), which, since its activation (in biological bodies) begin to distinguish (sensor specific) signals and transmit them for further processing. Such treatment requires that the received signals activate a subsequent biological process of self-creation of specialized "resource-saving" brain tissue – the prototype of file/strip of tape from the Turing Machine. In parallel with the construction/ growth of brain tissue, a process of filling/ loading it with "proto-information " is carried out – by loading initial images of individual events from around (in parallel with the development of processing infrastructure). Afterward, it follows the process of building natural *links* in the brain tissue - materialized logical relationships between different "saved" images of events. A case of such Self-creation-evolution of "processing structure" in the presence of a stream of sensory information - "eye-opening" is well described by biologists in [Hubel, 1988]

In the model used here (as of ##3) such initial load is accomplished by filling all the (random) images received from sensors in the array MS_i as prototype entities. Later, based on statistical principle, in the memory remain the most often repeated ones ("scenes" with separate proto-objects). Such Statistical filtration discriminates the closest, most frequent, respectively – the most important (for the adolescent individual) image from the sensors, and all others simply disappear, fade away. The young individual (especially the class of senior complex animal species - mammals, etc.) at the initial start of loading in information about the world around itself, is controlled and directed/managed (!) by parental organisms, thereby bringing forth the peculiar and original additional independent *external filter* for useful and harmful items, phenomena and events, that should be remembered or forgotten as a specific semantic and pragmatic information filed for the relevant species. This statistical method of initial discrimination of truth and utility in a "Brown movement" information space, supported by some framing parental entity with an already mature information-pragmatic system, correlates very well with the famous Goebbels empirical theorem (based on the work of [Bernays,1928] (since the beginning of the previous XX-th century) that "*a lie repeated 100 times by official place becomes public true*".

"Initial loading of information" in an organism can be considered successfully completed for natural entities - animals (of 4th and higher hierarchical level) in reaching their pre-puberty to independence (separation from parents or from the herd), which marks the beginning of a phase of "sustainable growth" of knowledge storage for an information-seeking system as a function of its own metrics for sustainable structural differences, and mostly for utility. For artificial entities of the (4+) level, within the well known modern laptops and tablets in the "e-shop paradigm", the phase of initial loading terminates after installation of an operating system, application packages, communication packages, a set of end-user interfaces, etc, but before the end user purchase.

Post-initial information loading, in the case of Homo Sapiens evolution is structurally described in [Gellner,1989], were the scripturalism of primitive religions, Platonist Conceptualism, Cartesian

Conceptualism as result of informational expansion of Homo Sapiens' civilization, are well connected to the civilization's technology level. Hence one more time the pragmatic aspect of the fs_j/ms_{jjk} construction rules are linked to the species' GEF and its own complexity level.

Lemma 8: (determinism and stochasticity)

The increase of one's own capacity for (absorbing pragmatic-) semantic information in (natural) *Observers* is a stochastic process in time, partly depending on:

- the local state of the *Observer*;
- the environment of the Observer (and from which it receives signals recognizable as entities or as an illustration of ordered relationships/ interconnections);
- the capacity of the *Observer* to create and verify new interconnections from the resulting signals, on one hand, and between registered entities and registered relationships, on the other hand, within an exponentially growing volume.

Typically (as the information/knowledge capacity naturally increases in time for all natural Observers), the first increase of the array begins with new templates (new entities) in the MS_{ij} set, followed by the construction of new relationships in the corresponding fs_j/ms_{jj} set for this new entity (interconnected with all existing previous ones). And only then does a non-zero pragmatic assessment begin with respect to the incurred increase in information "records" and the "entry" of this assessment in Δ_j set. Hence, we can talk about many "pre-pragmatic" information logs in the memory of the *Observer*'s mind, which depends on its physical capacity for memorization and the intensity of its own (for the *Observer*) association capacity. Here, the preliminary information is divided into two parts: just formatted sensory information (first-order sense) and committed, bound sensory information (second-order sense), complemented by a range of identified relationships with all other information available in the *Observer*'s knowledge base. Information from the "third order sense" forms the *Observer*'s own sustainable knowledge, based on second-order information complemented by non-zero pragmatic assessment, as final pragmatically approved information - the "knowledge". We may also talk about special information from type "fourth order sense" in senior systems of (4+) and 5th hierarchical level. This is the fraction of identified lack of information (!) about some key components in a complex, hierarchical model of material/information entity (theory or plan of some material object) for which the placeholder has already received a non-zero value of usefulness in Δ_j, and which is becoming the subject' job for information retrieval.

In this context, the dynamic (information based) stability of the *Observer* should be considered to function as a combination of two information processing sets - the first (**type A**: knowledge) which possess functional completeness and sustainability (i.e. for each data object/entity MS_{ijk} and for relationships from fs_j /ms_{jjk}, there exists a valid Δ_j component), and the second (**type B**: fantasies, feelings, intuitions, information noise), which have adequate components, but are functionally incomplete (respectively unstable) – i.e. there are missing non-zero values definitions in Δ_j, and even missing components fs_j /ms_{jjk}, which complement separate (often newly loaded) entities' definitions in MS_{ij}.

The principle of "rationality's growth" is presented once as a generation of new entities and relationships of the [type B] data-set, and then as a migration of multiple elements/entities and their relationship sets from the [type B] data-set to the [type A] data-set.

- In the natural evolution of Observers, the volume of the [type B] database often exceeds many times that of the [type A] database, and these Observers do not have an easy and effective way to balance the volumes of bases/sets of [type B] and [type A]. There often arises an overload (full or partial) of the total physical capacity for data storage in the Observer's memory, which leads to cases where the information of [type B] can destroy information of [type A].
- In the opposite direction, the considerable pragmatic value of certain information under stressful conditions can lead to blocking of certain sensors for new information, identified partially with the [type B] database, block 'tail' assessment/engagement of newly discriminated entities, dooming them to a statistical relegation or smoothing memory, and the specific Observer may limit his/her natural instinct for informational improvement/increase, even when the level of such natural drive is under the lowest limit of its information capacity.
- The gradual filling up of fs_j/ms_{jjk}, Δ_j, initiated by a new member in MS_{jjk} within a [type B] set, is not a linear process of dependences. The emergence of a new relationship is often the result of stochastic arrangement somewhere in time (in the life of the Observer) of a kind of puzzle of elements ms_{ij}, fs_j /ms_{jjk} in a sustainable/non-contradictory combination, generating a new relationship record in fs_j/ ms_{jjk}. This new definition of a relationship should be confirmed either statistically on the basis of a particular repetitive history, or (only for actual information-seeking Observers of the hierarchical (4+) level , or for a structured group made of Observers and artificial (purpose-built) components of level 5) by "planned experiments", or (least but not last) by analogy with other relationships from the [type A] range. In a similar manner, in time, after the "justification"/validation in fs_j /ms_{jjk}, there occurs (based on the arrangement of the puzzle sequence) a new record in Δ_j, leading to the migration of a hypercube of entries/ records MS_{jjk},

fsj /ms$_{jjk}$ from the [type B] database (fantasies) to the [type A] database (pragmatic proven knowledge).

Management of pre-pragmatic information is performed exclusively at the local level (in the Observer's "semantics management" system), under a very limited possibility of external influences. Similarly, the "pragmatization" status of new information occurs locally, and not on any external global level. Only in systems of the 5th hierarchical level, a (4+) level Observer can extract "pragmatizing" correlation based on the observation of actions of other Observers - actors of the (4+) level, directly observable in close vicinity of the subject entity, by using the principle of implication. This opens up the possibility for different entries in the memory of the individual, both with regard to interconnections in *fs$_j$ /ms$_{jjk}$*, and to assessments of utility in Δ_j. Hence, the process of adding a new element in ms$_{ijk}$, performed by two (e.g. identical!!!) independent Observers, in general leads to mutually <u>different</u> additions to their ranges/sets *fs$_j$ /ms$_{jjk}$,* Δ_j.

Lemma 9: (growth)

Increase in knowledge, i.e. the extension of volume in the array of pragmatic information of [type A] (i.e. *fs$_j$ /ms$_{jjk}$,* Δ_j), does not take place as a smooth function of increase in relation to the transformation described by partial migration from the set of pragmatic information of [type B] to a set of [type A], but as a step-based/nonlinear function of block growth (and its related subset) in (both images, relationships and rules)' sets of [type A].

Managing the transition from pre-pragmatic semantic information to pragmatic one, is based on the principle of the sudden, often "explosive" group validation of often random volume input entities or primary relationships. For each *Observer*, compared with other similar ones, the concrete "step" in the growth of pragmatic information base is strictly individual and not subject to full synchronization of external factors.

Proof of Lema 9 can be derived also from the standard structure of the new information item as a new theory, described by a matrix of transitions of equation (1) (from ##02C) .To have a smooth increase in the [type A] set (of the *Observer*'s infrastructure) when transiting from the [type B] sets, the new validated theory absorbed into a set of [type A] should have a single bit of information, or a single state binary process that is being observed. Such an increase can exist if and only if, at the trivial initial stage of self-development/ autopoiesis, during the initial (often external) load, an arrangement of elementary entities or relationship definitions according to minimal elementary structures is of zero (!) volume. Each subsequent supplement (e.g. new entities added) suggests applying the trivial transitional matrix of the

new entity to all other registered entities, which makes the volume of information, required no longer single-bit, and from there this growth becomes exponentially explosive/jump-wise, without any smooth graduation. The "magnitude" of the step depends both on the size of the validated theory and the size of the existing subject's knowledge base – of both [type A] and [type B], to which a new set of relationships is created (either trivial zero, or explicit non-zero ones). The larger volume of [type A] knowledge that the assessed subject/ *Observer* has, the greater (as a local volume information) will be the next step increase in its local information system infrastructure.

Theorem 4 (on the expanding semantic divergence) (or "***the Tower of Babel***" theorem)

Let us assume that in an Universe with unlimited semantic entropy *Cuniverse* ->∞ *there exist only two Observers i, j,* self-developing in time t respectively with a (entropy metrics for information) capacity Co(i, t), Co(j, t). When the Observers exist indefinitely long time, as a consequence of CorollaryL2, the differences between their (extending) semantic capacities (as a specific content of ms_{ij}, fs_j /ms_{jjk}, Δ_j sets) increase over time, i.e. (expressed by divergence):

$$\begin{gathered}\textbf{lim}\ Dkl(Co(i,t), Co(j,t) \to \infty \\ Dkl(Co(i,t), Co(j,t) \to \max(|Co(i,t)|,|Co(j,t)|\end{gathered} \tag{7}$$

and the percentage part of semantic information transmitted between them approaches zero

$$\textbf{lim}\ Inf(t, i/j) \to nill \tag{8}$$

where Dki is Kullback-Lieble divergence.

The above statement illustrates the "local" basis of knowledge growth within Observers of the (4+) and the next 5th hierarchical level, and raises the issue of controlled (and often quite expensive !!!) synchronization of the cognitive processes in natural individuals of the (4+) level, taken as components of a system of the 5th level.

The above theorem, deliberately called the "Tower of Babel" syndrome, requires an explanatory comment. Our ancestors have left to us knowledge and understanding that we have failed to comprehend and accept for over 4,000 years.

- *Why does the Tower of Babel stretch high to the heavens and to God, and is not described instead as a taller or more disproportionate analog to the Egyptian pyramids, which existed at the time when the Bible was written and would also be difficult to construct even according to today's standards? Because the Tower of Babel is a concept, the symbol of the infinitely-*

complex project, and for the biblical Civilization the material equivalent of such infinite project is precisely the construction of such a tower, reaching towards the unattainable God (i.e. the Gödel*'s complement of the current civilization knowledge). Had the tower been a smaller project (e.g. another pyramid, or even a new Great Wall of China) which required relatively limited volume of knowledge, then relatively soon the different participants would arrive at a "table of transposition" for the semantic capacities of the individual entities in the group that covers all aspect of such simple constructions (e.g. 1) "bring stones", 2) "Cut stones in shape", 3) "heap and order stones" ...) and then would finish successfully the project.*

— *Why is the Tower built by different tribes, not just different subjects/citizens of a state or a tribe? Because various tribes and their men are a symbol of individual independent Observers (i.e. complex conscious entities), subject to specific language communication/individual* MS_{ij} *content, subject to independent self-development and their own, personalized independent semantic capacity. Even then (for the creators of the Bible) it was intuitively clear that the individuals of a tribe were not structures of the animal 4th level, but rather of the human level of (4+) level, where their personal inner semantic entropy (as a quantity) is not the result of personal self-development only, but a result of an external, tribal led "initial information load", from the time of their childhood and youth, through the tribal language of communication, in the tribal zone of daily verbal exchanges and tribe technology for material (and communication) turn-around . All that allows the semantic synchronization of a very high extent – aiming their independent activities through the opportunity for effective pragmatic semantic communication.*

The above theorem is applicable to individuals' components in large Civilizations of the modern post-Neolithic conversions. - The more independent identification that separate components of Civilization pursue in their development, the lower is the efficiency demonstrated at the channel of semantic-significant and pragmatic information exchange within this civilization. In such cases what is valuable information about a person/element, is a standard white noise for another person/element. And the total reaction decreases and tends towards saturation to a level threatening the sustainable existence of the whole organism of 5th level – both tribe, state, empire or even modern globalized Earth Civilization.

Corollary A to Theorem 4 (T4A): In systems of the 5th hierarchical level, the ratio between components/persons exchanging pragmatic semantic information and components/persons exchanging "white noise" is as much higher, as the volume of uniform initial information-cognitive load for all individuals of the (4+) hierarchical level in this system is larger.

The outcome above is fundamental for building an initial education system for the individuals in a non-dying civilization and can be used for preliminary assessment of the educational systems of different civilization levels and instances.

Corollary B to Theorem 4 (T4B): In systems of the 5th hierarchical level, the internal exchange of pragmatized semantic information is as much higher as is smaller and simpler the volume of the "alphabet" used in inter-species / inter-instances / inter-components communication.

The above result is fundamental for assessment of the potential capacity of different civilization implementations/instantiations targeting inter-component communication, based on their usage of an information coding system - articulated speech (and a thesaurus of simple words - names of entities and grammar rules) and mass literacy (for indirect, non-volatile, non-brain, material based data storage and coding) It is well illustrated by the disappearance of many primitive neolith civilization instantiations, based on difficulties to standardize pictogram based names/ atoms in language coding in all continents of the Earth.

Corollary C to Theorem 4 and to Lemma 9 (T4CL9), The proposed proof of lemma 9 suggests another important property of pragmatic information paradigm – a higher than exponential - in reality a factorial complexity and a required processing power (for "brute force" algorithms), needed for sustainable "knowledge growth". This property can limit the popular concept of the "technological singularity" of the awaited artificial intelligence (AI) as total successor of Homo Sapience in the near future.

The concept of "technological singularity" was introduced by J. von Neumann and S. Ulam (as of [Ulam,1958]) as a nearly parabolic extrapolation of the introduction of Turing machine as an artificial information processing component. It has been thoroughly elaborated in the context of near exponential "Moore's Law" concerning the computer processing power growth in the last half century. However, the task of factorial complex analysis could not be solved by exponentially extended machine. And the trivial solution - the (practically unlimited) parallelism – has to break apart when confronted with the above Babel Tower Theorem limitation, a few stages after the exhaustion of the natural Homo Sapiens intellectual capacity.

Acknowledgements

I would like to thank Kr. Markov for his valuable objections and suggestions on previous drafts of the paper as well as Y. Zlateva, which helped my English translation to become more readable.

The paper is published with partial support by the project ITHEA XXI of the ITHEA ISS (www.ithea.org).

Annex 1:

Hierarchic multilevel paradigm of Universe (Mendeleev's table of the known World)

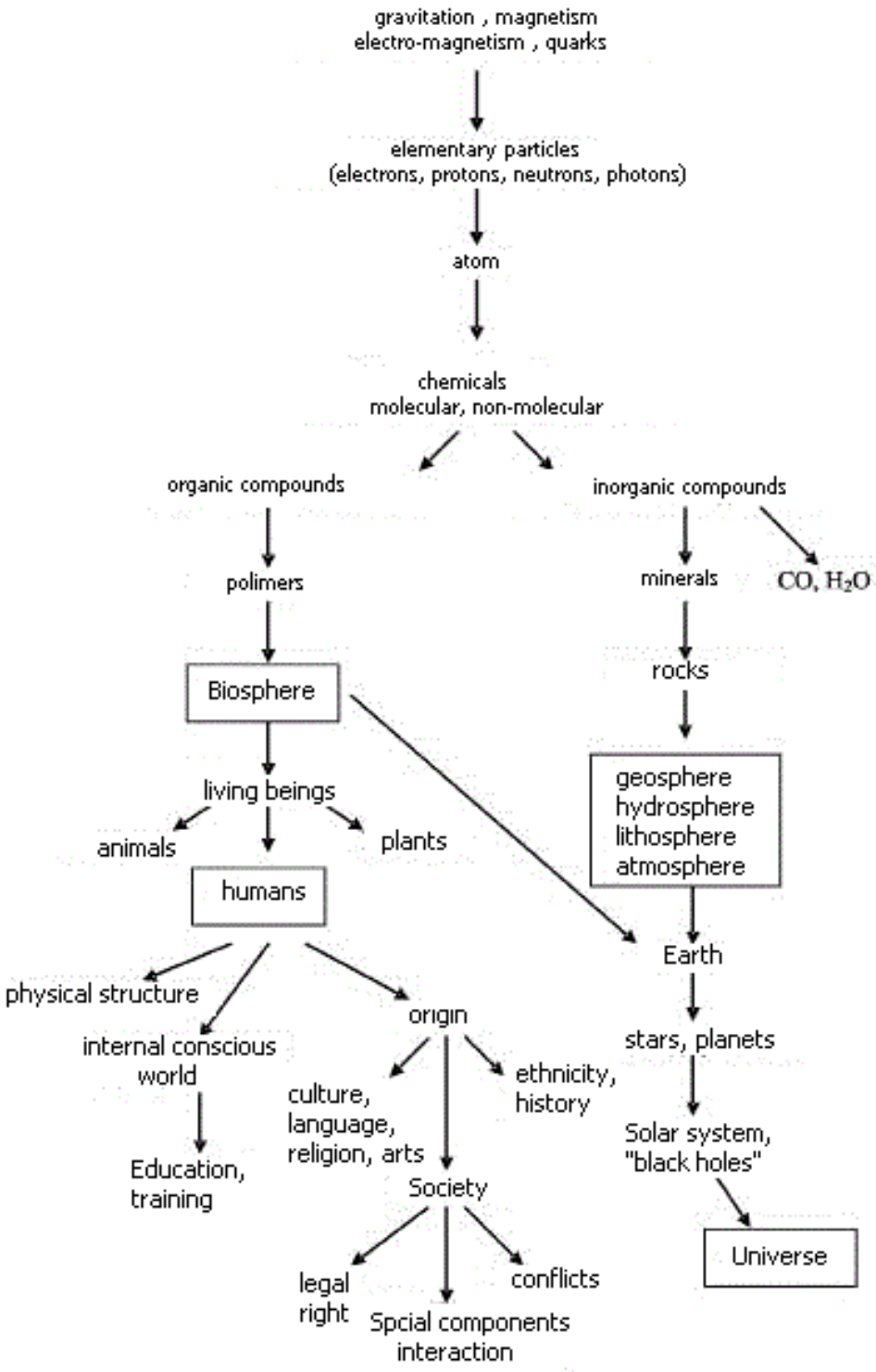

fig A. Sirotkin's Model on Univers structural Hierarchy

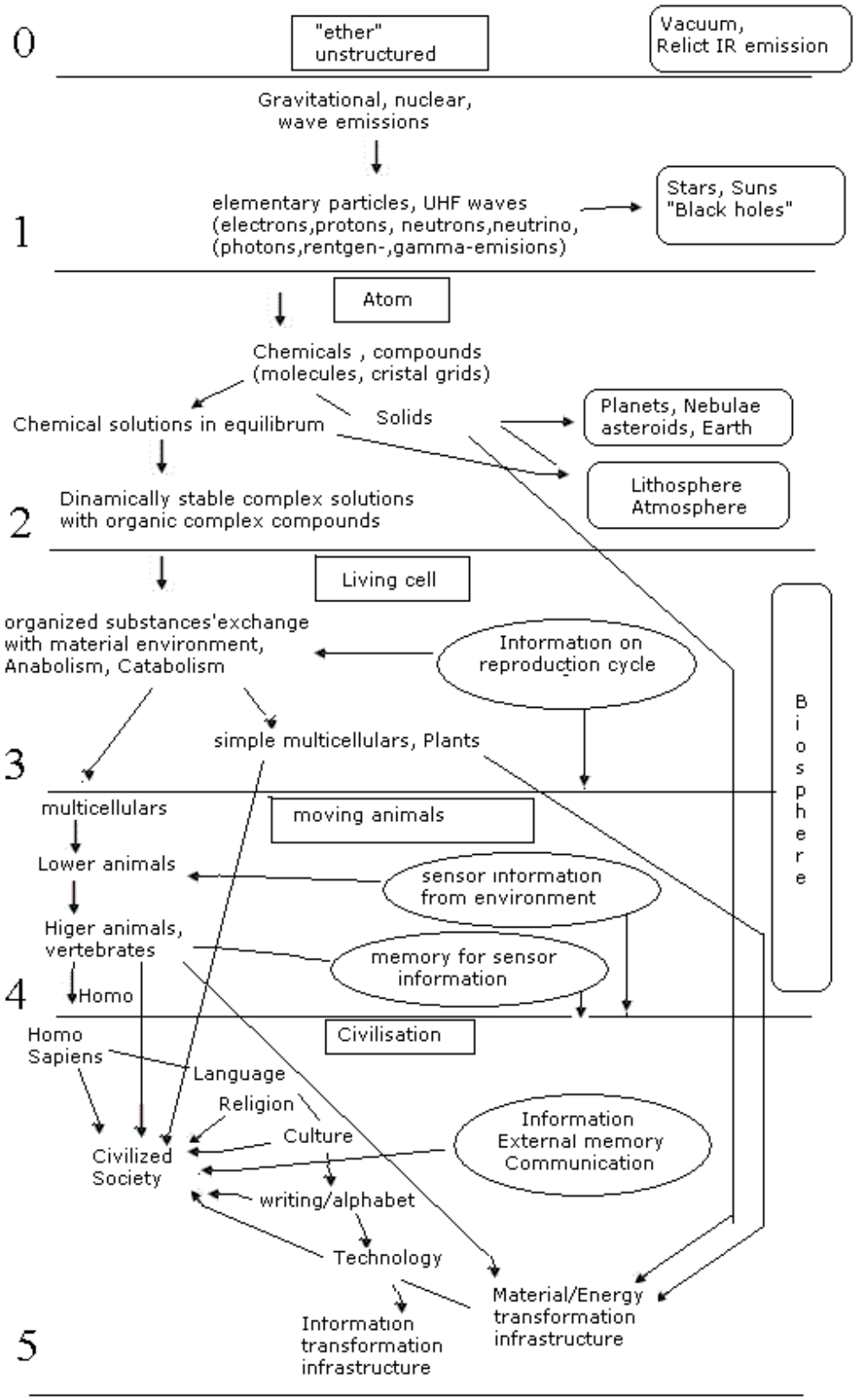

fig B. Bojilov's Model on Univers structural Hierarchy

A draft of this model has been made in 1978, but this is its first public proliferation

Bibliography:

[Adriaans, 2010] Adriaans, P. "A Critical Analysis of Floridi's Theory of Semantic Information" , Knowledge, Technology & Policy June 2010, Volume 23, Issue 1-2 S, link.Springer.com

[Alfven, 1984] Alfven H." Cosmology: Myth or Science?" Journal of Astrophysics and Astronomy vol. 5, March 1984

[Arieti, 1959] Arieti, S,, "Schizophrenia," American Handhook of Psychiatry, S. Arieti editor, vol. 1, New York, Basic Books, 1959.

[Bar-Hillel & Carnap, 1953] Bar-Hillel Y., R. Carnap "Semantic Information" The British Journal for the Philosophy of Science, Vol. 4, No. 14 1953

[Bernays, 1928] Bernays E. " Propaganda" Routledge 1928

[Bertalanffy, 1969], von Bertalanffy L. "General System Theory: Foundations, Development, Applications" George Braziller, Inc. New York, N.Y. 1969

[Brown, 1975] A. P. G. Brown, "Modeling a Real-World System and Designing a Schema to Represent It", in Data Base Description, North-Holland

[Bruner, 1958] Bruner, J. "Neural Mechanisms in Perception," in The Brain and Human Behavior, H. Salomon, editor, Baltimore, Williams and Wilkins, 1958.

[Burgin, 2010] Burgin M." THEORY OF INFORMATION Fundamentality, Diversity and Unification" UCLA 2010 World Scientific

[Burgin, 2011] Burgin M. " Information in the Structure of the World" IJITA Vol.18 No 1/ 2011

[Cantril, 1962] Cantril, H., "A Transaction Inquiry Concerning Mind," Theories of the Mind, J. Scher, editor, New York, The Free Press, 1962.

[Chen, 1975] Chen, P. "The Entity-Relationship Model: Toward a Unified View of Data" ACM on Database Systems, Vol. 1, No. 1 1976

[Chomsky, 1965] Chomsky, N. ASPECTS OF THE THEORY OF SYNTAX 1965 MIT press

[Dodig & Hofkirchner, 2011] Dodig-Crnkovic,G., W.Hofkirchner "Floridi's "Open Problems in Philosophy of Information", Ten Years Later" , www.MDPI.com

[Floridi, 2003] Floridi ,I. "From Data to Semantic Information " Entropy 2003, 5, www.mdpi.org/entropy

[Floridi, 2009] Floridi,I. Philosophical Conceptions of Information" in (Ed.): G. Sommaruga "Formal Theories of Information", Springer-Verlag Berlin Heidelberg 2009

[Geertz, 1962] Geertz, C. "The Growth of Culture and the Evolution of Mind," Theories of the Mind, Jordan Scher, editor, New York, The Free Press, 1962.

[Gellner, 1989] Gellner Ernest "Plough, sword, and book : the structure of human history" University of Chicago Press edition 1989

[Genesis 2/7] Holly Bible, Old & New Testament, ed.1998 Bulgarian Orthodox Church

[Gödel, 1931] Gödel K. " The formally undecidable propositions of *Principia mathematica* and related systems I. "In: K. Gödel. Collected Works. Vol. I. Publications 1929 – 1936. Oxford: University Press, New York: Clarendon Press – Oxford, 1986

[Hecht, 1931] Hecht, S., "Die physikalische Chemie und die Physiologie des Sehaktes," Erg. Physiol., 32 (1931).

[Hofkirchner, 2012] Hofkirchner W."20 Questions for a Colloquium BITae : Can a Unified Information Approach be achieved" 2009 Colloquium BITae, BITrum Project: Intedisciplinary elucidation of the Information Concept

[Hu & Feng, 2006] Hu, W. and Feng, J. Data and Information Quality: An Information-theoretic Perspective, in Proceedings 2nd International Conference on Information Management and Business, Sydney, Australia, 2006

[Hubel, 1988] Hubel D. "Eye, brain and vision" (in Russian) MIR 1990

[Inspire, 2012] D2.8.III.12 INSPIRE Data Specification on Natural Risk Zones – Technical Guidelines 2013-01-21

[Inspire, 2013] COMMISSION REGULATION (EU) No 1253/2013 implementing Directive 2007/2/EC as regards interoperability of spatial data sets and services

[Katz & Fodor, 1963] Katz J. J.; J. A. Fodor "The Structure of a Semantic Theory" Language(Linguistic Society of America), Vol. 39, No. 2. 1963

[Kolmogorov, 1965] Kolmogorov A.N. Three approaches to the definition of the quantity of information, *Problems of Information Transmission*, No. 1, (1965)

[Luhmann, 1986] Luhmann, N. "The Autopoiesis of Social Systems." in *Sociocybernetic Paradoxes: Observation, Control and Evolution of Self-Steering Systems*, eds. F. Geyer and J. Van d. Zeuwen. London: Sage. (1986)

[Markov et al, 2007] Markov.K, K.Ivanova, B.Mitov "Basic Structure of the General Information Theory", IJITA Vol.14 / 2007

[Marschak, 1954] Marschak, J. Towards an economic theory of organization and information, in *Decision Processes*, New York, (1954)

[Mazur, 1970] Mazur M. "The Qualitative Theory of Information", 1970 (in Russian) MIR 1974

[Mesarovic at al, 1970] Mesarovic,M, D.Macko,Y.Takahara "Theory of Hierarchical, multilevel systems" 1970 in Russian: MIR1973

[Morris,1938] Morris, Charles W. *Foundations of the Theory of Signs*. Chicago: The University of Chicago Press. 1938.

[Penchev, 2011] V.Penchev "Skolem's Paradox and Quantum Information. Relativity of Completeness according to Gödel (in bulgarian) Philosophical alternatives 2/2011 vol. XX

[Piaget, 1959] Piaget, J., The Construction of Reality in the Child, New York, Basic Books, 1959.

[Pütter, 1920] Pütter, A., "Studien zur Theorie der Reizvorgänge," I-VII, Pflügers Archiv

[Rashevsky, 1938] Rashevsky, N.,"Mathematic Biophysics", Chicago, The University of Chicago Press, I938.

[Shannon, 1949] Shannon, C., Weaver, W. "The Mathematical Theory of Communication". Univ. of Illinois Press Urbana 1949.

[Sirotkin, 2011] Sirotkin O.S. "The System of the Universe as Fundamental Basis of Unified Classification of Natural Scienses and Humanities"(in Russian) Journal of Advances in current Natural Scienses , 2011 Kazan State Power Engineering University, Kazan, Russia

[Skolem, 1922] Einige Bemerkungen zur axiomatischen Begründung der Mengenlehre. In: T. Skolem. *Selected works in logic* (ed. E. Fenstad), Oslo etc: Univforlaget. 1970.

[Spengler, 1922] Oswald Spengler „Der Untergang des Abendlands" vol 2 Munich, Beek, 1922

[Ulam, 1958] Ulam, S. "Tribute to John von Neumann" 64, #3, part 2. Bulletin of the American Mathematical Society: 5. 1958

[Werner, 1957] Werner, H. Comparative Psychology of Mental Development, New York, International Universities Press, 1957.

[Wiener, 1961] Wiener, N. Cybernetics, or Control and Communication in the Animal and the Machine: MIT Press and Wiley, New York, London (1961)

[Matson, 1964] Matson, F., The Broken Image, New York, George Braziller, 1964.

Authors' Information

Venco Bojilov *–member of INSPIRE TWG NZ, now with Bulstrad VIG plc*

Major Fields of Scientific Research*,: Distributed Data Bases, General Information Theory, Cognitive Science, General System Theory, Natural Risk and Risk Management theory*

e-mail: vbojilov@bulstrad.bg, patilan_bojilov@hotmail.com