We are such stuff as dreams are made on, and our little life is rounded with a sleep

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The trilogy 'Consciousness in the Universe is Tuned by a Musical Master Code' by Meijer et al, published in Quantum Biosystems, vol 11, no. 1, 2020 is reviewed.

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The title comes from this excerpt:
The Tempest Act IV, sc.i William Shakespeare (1564 – 1616)
PROSPERO [Aside] I had forgot that foul conspiracy / Of the beast Caliban and his confederates / Against my life: the minute of their plot / Is almost come.
To the Spirits / Well done! avoid; no more!
FERDINAND [Miranda´s fiancée] This is strange: your father's in some passion / That works him strongly.
MIRANDA [Prospero´s daughter] Never till this day / Saw I him touch'd with anger so distemper'd.
PROSPERO You do look, my son, in a moved sort, / As if you were dismay'd: be cheerful, sir. / Our revels now are ended. These our actors, / As I foretold you, were all spirits and / Are melted into air, into thin air: /; And, like the baseless fabric of this vision, The cloud-capp'd towers, the gorgeous palaces, / The solemn temples, the great globe itself, / Ye all which it inherit, shall dissolve / And, like this insubstantial pageant faded, / Leave not a rack behind. **We are such stuff / As dreams are made on, and our little life / Is rounded with a sleep.** Sir, I am vex'd; / Bear with my weakness; my, brain is troubled: / Be not disturb'd with my infirmity: / If you be pleased, retire into my cell / And there repose: a turn or two I'll walk, / To still my beating mind.
FERDINAND, MIRANDA We wish your peace. / *Exeunt*

Introduction

I am honored to have been asked to make these comments, but with double feelings. I do not feel easy with the reading I was able to make of the contents. I remember a classic book on `The Two Cultures` (Snow 1960, in Meisenberg, 2018), referring to the difficulties in establishing productive discussions between those learned in the ´harder sciences´ and in the ´humanities´. I feel more or less the same here, perplexed at the confrontation between my background in medical and biological sciences, and the deep layers of physics, contained in the target articles. My clan is immersed in a nano- to mesoscopic scale objects (e.g., involved with the problems imposed by the coronavirus pandemic of 2019, from epidemiology to drugs and vaccines) while the authors being commented upon are in the world of infrared frequencies and magnetic fields, quantum entities ….. They aspire to contact reality through means which sometimes seems to be mostly the tools of mathematics, algorithms and platonisms.

I don´t feel authorized to discuss about the cosmos. I like to stand on earthly grounds. This is already too complex and scarcely known, occupying much of my limited possibilities. It is under this context that I will observe some of the contents of the target articles.

The title I chose goes in the direction of stating this deeply human problem: we design futures but we end up in a sleep.

Nature may be blind to us, but we cannot afford ourselves being blind to it because we depend on it.

Mind and matter My feeling on the readings is of perplexity. This is perhaps justified by the nature of 'the hard' problem in the philosophy of mind, which is consciousness, and the correlation or separation [in more sophisticated physical terms, ´symmetry-breaking´] between mind and brain.

Mind belongs to the nearly transcendental realm, extra-terrestrial, brain to the biological, the earthly nature, to the bodies of living beings, from cells to multicellular organisms. Research stems from both aspects aiming at a conjunction, which proves difficult to reach.

How to attribute consciousness or feelings to matter? It may be hard to accept but there is no alternative, unless biochemical objects, molecules, are only a material part of the subject that has another part which is either not accessible to biochemists or they are neglecting it.

In some realistic sense, all agree that it is only among ourselves humans that we can be sure of observing consciousness.

There are some indications of characters composing the concept in other organisms, but problems amount to the same magnitude as the doubts about the meanings of the tests we utilize for the detection.

Some researchers, more on the philosophical side (Hunt and Schooler 2019; Meijer et al. 2020a-c), are explicit in attributing to all matter the character information, which seems to have gained general agreement. With respect to consciousness, there is still some resistance to the more radical proposition that all matter would have it – panpsychism. I could say that most biologists would accept a more moderate and evolutionary perspective. In the paper by Hunt and Schooler (2019), this divide is exposed between the authors, Hunt a panpsychist and Schooler more moderate in the depth of the distribution.

One proposition that could gather wider support would say that minds are proper to the living, so that all cells and all species would have the property of consciousness but each one with its own kind and amplitude.

Let´s say minds of bacteria, of archaea, fungi, plants, and of animals, minds of worms, bats and mammals and so forth.

The physicists and panpsychists say that there is no divide in the kinds of matter across all the organization levels, or in the kinds of attributes with which they say consciousness would be correlated with. The more biological side would say that cells and multicellulars have some peculiar organization, e. g., the highly plastic adaptive networks of biomolecules, in which the correlates of consciousness would reside. What would be observed in abiotic materials should be called perhaps pre- or protoconscious.

Cards on the table, let´s wait for the ingenuity and creativity of both contenders, to add tests and challenges to see where the areas could advance to reach convincing demonstrations.

It might also happen that the association of consciousness and all matter will become of such wide usage that all people will consider trivial the discussion, so this and the doubts fade away.

My observations indicate that the proposition of a radical jump from other primates to the human will not prevail, also making room, by extension, to the gradualist rise, from single cells to the multicellulars.

The other jump, from the inanimate to cells, might be harder to gradualize.

One possibility of solving the jump problem would be in the area of synthetic cells.

If these can be built from scratch, joining molecules to the point of having a cell constructed, we´ll possibly see complex behaviors showing up and showing that there is no mystery involved.

Here, the first part of the title would find a nice justification.

All is built on the same stuff, from stones to poems.

The panpsychist stuff is composed of matter (mass, energies in the four kinds of classical physics, information, and conscience (or proto).

Conscience would be one more and just like the irreducible properties of matter such as the positive charge of the proton, the negative charge of the electron, the absence of charge in the photon or in the neutron.

A manifest advantage of this proposition is in dispensing with the need for emergentist approaches. These are necessary for the biologically inspired divide, the jump from the inanimate to the animate.

Electrical brain The panpsychist worldview presents to the reader the brain as a dedicated electrical organ. The view proposed by Hunt and Schooler (2019) says of the passage from the electrochemical level to an electromagnetic field level, this being able to provoke efficient synchronization between different parts of the brain, fulfilling the requirements for action at long distance and with ultrarapid speed.

The perspective offered to the biologist is that its little world is dedicated to reproductive fitness via the adequate complex behaviors and via the amplification of brain memory and memory expression space.

Consciousness would arise as a by-product, perhaps auxiliary in the fitness composition, but not as a direct focus of selection (we´ll come back to this topic later on).

The large brain resulting from those necessary functions became apt for developing consciousness, which is a physical result from size.

Consciousness would be present from the subatomic level, physical and inanimate, all the way up to the human brain, still physical but now part of the bioworld.

The divide lets neurons in charge of biological specificities such as firing spikes and building synapses for memories, structures, motions, metabolism and behaviors of relatedness to environments, while consciousness would be more linked to the glia, intercellular matrix, and the liquids where everything is immersed.

It is possible that what the target article pg 85 refers to is this same reasoning, in a citation to ´higher cognitive functions creating consciousness as a paradox´ (Allakhverdov, 2000).

It would be nice if we could get access to the source.

The work reviewed in the target articles starts where the Hunt and Schooler (2019) ends.

This is dedicated to clarify on the hypothesis that consciousness arises in two steps of the conjunction, combination or binding among different areas of the brain to form a synchronic (harmonic, coherent) whole.

Such integration would, consequently, involve the whole body in a fulfilling sensation (sentiment) of plenitude.

The steps in the combination would be from the molecular cell to the electrochemical binding, which is not fast enough, and from this to the electromagnetic, this satisfying the requirement for speed.

The combination steps are generic and not dependent on the specific contents of each episode or event of consciousness, which may stay in the biologic molecular realm.

The target articles are dedicated to exploration of the ´semi-harmonic electromagnetic background field frequencies´, which they discovered to compose patterns that are similar to the modern musical scales – 12 tone, octave-like – and reminiscent of the Pythagorean.

The theory is abbreviated EMF-GM; electromagnetic field, generalized music.

It is intriguing to observe the series of life-compatible frequencies intercalated regularly with and very close to, in their words, life-threatening frequencies.

It is seemingly so dangerous, near criticalities.

They report that the pattern may be generated from internal mechanisms or may be induced – resonating – by exposure to external radiations. The pattern may arise from the most diverse kinds of materials, pure water, mineral crystals, material extracted from and produced by cells, or synthetic mimics of the biologics, so that it is a generic property of matter.

Inside bioorganisms, therefore, the bulk of it would be water (possibly its hydrion form), inorganic ions dissolved in it (with special mention to the calcium waves), plus the large variety of metabolites and then the macromolecules.

In the possession of all this stuff, including the non-specificity of the EMF-GM pattern and considering that the biologic material is such a very small portion of all matter in the universe (good to remember that it is a reasonably large fraction of time 3.8 Ga of life on Earth / 13.8 Ga total), they feel authorized to construct a theory for the universal evolution.

The whole is a giant information-processing system, which includes all of evolution – from the physical to the biologic realms – and proceeds after the death of organisms. The information generated in all steps and domains would be eternal and driven to compose the omega information point.

Origins of cells With respect to biology, they say that the origins of cells would have been partially driven by the inorganics, especially water, whose structures would help and partially direct the organization of the biomolecules.

I would consider it better to attempt to avoid the rationality based on singular factors and forces, that may join to form associations. Let´s consider that the interactive properties of particles or bodies are exhibited in their surroundings as fields.

All movements that we observe are consequent to the interactions among the fields of the interactants and result from the mutuality in the interactions – movements are relative to all interactants concomitantly.

Cells were born in water but are constituted of some specific organic polymers, it can be said that the configuration of the biosystems resulted from their interactions.

The polymers are not biologic when synthesized in the chemical factories, water is not biologic when transported in comets, but they are biologic when they are together and harmonically in cells.

The harmony may last in the dry state for some time, e. g., in viruses, but these are surely derived from cells. Other limit situations may be recalled, adding to the controversies, but we consider it safer to stay in the realm of the mutuality and of interactions, in the place of extending the rationality to the irresolvable limits of the infinites, which gets closer to the unreachable irrationality.

Life detox My present hypothesis for the origins of cells is that it came up from non-biotic geochemistry as a by-product of the chemical process of detoxification of organic acids and keto-acids by amination.

The keto-acids reacting with ammonia produced the amino acids.

These were utilized by prebiotic peptide synthesis guided by proto-tRNA-like oligomers, these synthesized on crystals.

Polymerizations were not substrate-specific, so that peptides were produced together with other oligomers.

Biological entities arose when a self-referential and self-stimulated protein synthesis system developed, after the products peptides and the producer proto-tRNAs got bound together in a protein producing system (Guimarães, 2017).

This scheme forms a loop at the meeting with the present climate changes.

Life started from detoxification mechanisms acting on geochemical proto-metabolic systems but is now facing another environmental toxicity crisis, caused by its own workings, the global warming from waste accumulated in the atmosphere.

Even more, metabolism is continuously producing toxics that have to be eliminated or dampened, as if maintaining inside its mechanisms, the seeds of challenges that are at the same time, necessary and harmful (e. g., the Reactive Oxygen Species).

Some of these become very dangerous for cell types that have difficulties in extruding them, such as the protein tangles of Alzheimer´s Disease, that do affect cognition, memories and consciousness.

Who drives what? The discussion on directional forces versus mutual interactions borders the metaphysical realm, deserving a short elaboration. I first read on it through a physicist (Lopes, 2000) ´*There are four types of fundamental forces in physics that are called interactions*´. A second reasoning is the ´*paradox of the infinites*´ that arises when we engage in the non-restricted, endless chain of questionings with respect to the first cause, the ´*primum movens*´, or to the contrary, the future of futures.

The only answer would be through a God-like entity, away from the earthly sphere. But how to consider the true and honest non-believers in this context?

Are they deficient, unable to feel God´s presence?

Being myself one of these, I propose that the character ´believer or non-believer´ (let´s say, about 85%-15% at present and across the countries, respectively) could be treated just like the genetic characters ´present or absent´,

and these would be considered a part of human biodiversity, both normal.

These propositions could then be submitted to Ockham´s razor, which would decide in favor of the non-believer, leaving the burden of proof to the believers.

In our case of the forces of nature, we could therefore, decide in favor of the explanation of movements through the mutuality of interactions of coequal partners, instead of the univocal and dominant action of one over the other.

Plasticity A third line of reasoning considers biological activities, of which the most typical and diagnostic would be plasticity. This resides mostly in proteins and can be amplified in the complex networks that they build through multivalent associations.

Protein plasticity is most evident in their ´intrinsically disordered domains´, configured as coils and turns, not the ordered ɒ-helices and β-strands that are able to form sheets.

The ordered segments are important for protein 3D structures, while the disordered are necessary for much of the activities.

A few most evident examples would be the cell surface receptors, that exhibit the ´empty´ states, mostly disordered, and the ´filled or busy, occupied´ states, ordered at the mutuality with the bound agonist.

Such states are most important for the regulatory mechanisms, in which the regulator may be different from the agonist but binding to the same site, or for the action of drugs and medicines.

The major role of disorder being intrinsic to biologic activities, more frequently called plasticity, was obvious for a long time already, only more recently demonstrated in proteins.

Water The participation of water in helping protein structures and activities is, by its turn, manifold.

There is bulk water in the internal milieu, which may present its own polarity-organized lattices; the nano-confined and surface-bound water, with diverse kinds of structures, accommodating with the surface materials.

Water molecules may be reactants in the active pockets of enzymes; it is produced at polymerizations and consumed at hydrolyses; it is excluded from hydrophobic pockets, from the interiors of ɒ-helices, of β-strands and sheets, and of nucleic acid helices.

It is apparent that such diversity would say more for the biodiverse mutuality than for a partial guidance by water.

Condensate bodies A more recent addition to the area of biohydrodynamics are the biomolecular condensates.

They are more frequently involved with ribonucleoprotein (RNP) processing but are not exclusive to these. They form droplets inside eukaryont cells and are, obviously, not visible in the tiny bacteria and archaea.

There are many classes in their large diversity, sometimes called also ´membraneless organelles´ (Alshareedah, 2020; Banani, 2017). Most notorious among them are the nucleolus, then the Stress Granules (Kato, 2012).

The latter are formed by some specific sets of proteins, rich in intrinsically disordered domains, that compose a network scaffolding the globules.

The proteins would hold under protection the RNAs that were dissociated from translation complexes during the stressing conditions.

The granules dissolve at the release of cells from the stress.

The globules are in the range of a hundredfold denser in macromolecular contents and their formation involves phase separation from the bulk water.

Processes of this phase separation kind are invoked, of course in different contexts, in both the Hunt and Schooler (2019) and in the target articles of this volume.

My utilization of these droplets is as a model for the protocell constructs, where intrinsically disordered early proteins bind early (proto)RNAs in RNP globules that are phase-separated from bulk water, not requiring membrane containment (Guimarães 2017, 2019a-b).

Distributed consciousness Besides the considerations on the topics posed by the target articles, I feel the need to ask about other aspects not covered by them, at the same time asking excuses for my ignorance.

Brainless organisms are the vast majority and, since they should also manifest the character consciousness – an assumption of the panpsychisms – it would be nice to have a

treatment or a classification of kinds and grades.

When the character is distributed in their bodies, it would also be applicable to the study of human bodies, as participants of the processes.

It may also be paradoxical the supposedly very important role of consciousness, which is highly justified for the human case, while this is only a small portion of the voluminous total biomass.

Furthermore, brained or neural tissue-bearing organisms (animals, from coelenterates on) are typically only predatorial, while the real and only source of biomass are the non-brained autotrophs – the true basal and sustainers of the whole biosphere.

Evolutionarily, brain-centered consciousness is associated to predation, either the hunters or the prey, all in need of speed.

This kind of ´predatorial´ relationship with environments is no novelty to the life-process, that has utilized and degraded its environment from the beginning, via metabolism, then at human origins, through the use of fire (Annaud, 1981; Pyne, 2015), up to the present-day extreme of the devastating industrial exploitation of the planet.

Individualisms It also struck me the individualistic contour of the studies, which is obvious to the intent of learning about the ´first-person approaches´, subjectivity and so forth. It is of note that our species is singular among the highly social, the most advanced in the ´cultural´ characters of learning abilities, all through the lengthy and highly care-dependent infancy, and with very high plasticity in comparison to the others where instinctive abilities prevail.

Much of these abilities are deeply related to the linguistic propensity and the social complexity.

One aspect of the sociality that might converge with the process of consciousness is what the psychologists and psychoanalysts value strongly, the role of the ´others´ in shaping the ´selves´ – again , mutuality.

What would be, then, the possible participation of social and linguistic interactions in shaping or in boosting the development of our kind of consciousness?

Would there be a deeper influence, beyond the mere ´big brain´ effect?

There are some ´natural experiments´ that might illustrate the point, the feral children, ´enfants sauvages´.

They state that ´humanization´, self-awareness and self-consciousness require rich environments and interactions.

In all forms of the living, individuals would not have survived in isolation.

I wonder whether these would be just additions to the basic ability of consciousness or they would participate also at the basis.

Process and bodies Biologists in general would like to praise more the specificity of biomolecules than the generality and non-specificity of water or other ions, but it is better to stay in the safe side of the mutuality of coequals.

According to this bias, the life-process is instantiated by living beings, which would be the drivers.

Living beings are (1a) metabolic flow systems, (1b) centered on protein synthesis, that (2a) self-construct on the basis of (2b) memories and (3a) adapt / evolve through (3b) constitutive plasticity (4) in relation to environments. A sketch (Figure 1) depicts these four pillars divided into two sets: one for the informational macromolecular core (nucleic acid memories and protein structures and activities), the other for the metabolic interactions and the integration of the living within itself and with its environments.

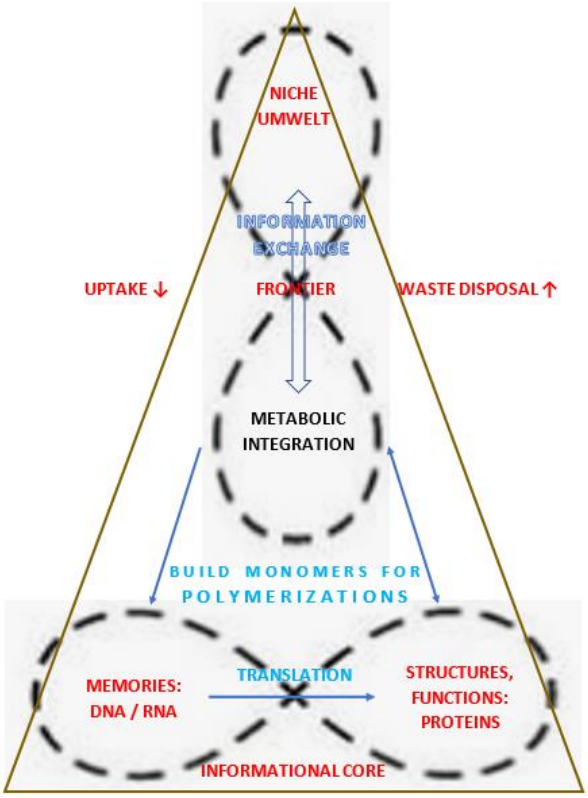

Figure 1. The four pillars of living systems. Lower sector is the informational core, with the genetic memories and expression mechanisms, and the proteins that build the structures and functions. The metabolic sector integrates the communication with the exterior through the nutritional flows, and the internal transformations for sustainment and synthesis of the core components. The umwelt concept comes from Uexkül (Kull 2001)

The accompanying Box 1 offers a small compilation of some key biological concepts.

The philosophy of processes and the processists may feel better with the description of the universe as a giant information processing system, within which living systems were instantiated.

Consciousness was present from beginning and all along evolution. It is possible to have both processes at work, the universal and the local. The latter may not have been foreseen by the former.

The two sides may be compatibilized fruitfully in some not much distant time. The conjoining should incorporate both scientific directedness and historical contingencies.

Futures My formation on earthly nature, when asked about evolutionary futures, answers more prudently.

We travel along the tortuous and multiple diagonal branching that may occupy the whole wide space demarcated by the Y axis of the school that aims at transcendence, such as the authors of the target articles, and the asymptotic to the X axis of the school dominated by the entropy-directed thermodynamics.

It is well said in the target article pg 2 ´Scientific endeavor in general should be conceived as a product of our consciousness in which, in fact, a part of nature investigates another part in full detail.´

This is an uroboric loop that can be understood as the primeval physical world of elements meeting, after traversing all of evolution, abiotic and biotic, its originators – in an informational closure of the system upon itself.

In fact, the target article authors do elaborate on these ideas later on.

They do not utilize the panpsychist terminology but it is an implicit and integral part of their theory.

Otherwise, they note (target article pg 97) the relatedness of this uroboric reasoning to the evolutionary ideas of Teilhard de Chardin and others, where evolution of information would be directed to reach an ´omega information point Ω´.

The ramifications of biodiversity see open-ended futures, with curiosity about the possibilities to explore and unknowns to come, no predictions.

Transcendence may be understood in the biological realm as the expansion of the material reproduction to the cellular continuum forming the lineages, plus the addition of the transmission of memories along the succession of populations and cultures.

Individual permanence on Earth reaches about a century, along the tragic Sisyphean trajectories.

Maximum extensions run along processes similar to the Marathon Relay Proof teams or the Fire Bucket human chains, that may reach the duration of species, in the range of millions of years.

Biological inheritance is about equal for the partners in each reproductive event. The memory and cultural transmission vary tremendously among individuals.

For many, it is just rounded with a sleep but, the title, it lasts already quite a few centuries. for the author of this assertion that I chose for

Box 1. Some key concepts in cell-molecular biology

Matter is composed of mass, energies and information.

Forces and **fields** are inferences from the observation of the primary data, which may be movements provoked by various interactions in a system.

Information is (1) the sum total of the patterns, shapes, activities, emanations, properties, fields and forms ... of the organization of the masses and energies of (2) the usually particulate objects (3) that participate in interactions or communications with other objects, including us. We sense it with limitations, through biological receptors or with the help of instruments. We cannot communicate adequately with other species.

Living beings are (1a) metabolic flow systems (1b) centered on the protein synthesis sink, that (2a) self-construct on the basis of (2b) memories, and (3a) adapt / evolve through (3b) constitutive plasticity, (4) in relation to environments.

Metabolism sustains the living beings through transformations of matter that is taken up from environments, which also receive waste.

Environments are, in consequence of biometabolism, transformed and degraded. Accordingly, the living beings have to continuously adapt / evolve to the changes they provoked, which means that **evolution is self-stimulating**. Besides these biotically driven dynamics, environments have their own, independent sources of changes and transformations.

Life is the sum total of the metabolic processes instantiated by livings beings, involving themselves and extended to the transformations they impose on the environments. It includes from ontogenesis to adaptations, and reproduction to form populations and lineages – phylogenesis – that instantiate the biological evolutionary processes. Living beings would not have succeeded along time without reproduction and evolution.

The **earthly evolutionary series** would be: 1. Quantum entities → 2. Sub-atomic particles and Atoms → 3. Molecules* → 4. Crystals** → 5. Oligomers (proto-tRNAs, structure unknown) synthesized on crystals → 6. Protein synthesis directed by dimers of oligomers → 7. Binding of the product proteins to the producer oligomers → 8. Mutual (self-referential) evolutionary adjustment of products and producers → 9. Self-stimulation (´autocatalysis´) of the producer-product system → 10. The producer matures the RNA structures → 11. RNA matures the string-memory (genetic) function → 12a. The string-memory function is transferred to DNA, 12b. The expression function is maintained in the RNA, 12c. The products are always proteins.

*Among abiotic organic materials, most abundant and possibly non-limiting would have been the One-Carbon-Units (e.g., methane, methanol, formaldehyde) seconded by Two-Carbon-Units (e.g., acetate and some derivatives, including Glycine etc.).

**Crystals would have been a kind of abiotic ´genetic´ material: stable, non-limiting, capable of surface-directed oligomerization of different kinds of monomers, including of their own kinds, which is replication-like.

String-memory refers to the organization of DNA/RNA sequences that can be expressed in protein sequences. These are the informational (evolutionarily organized, by natural selection) polymers / macromolecules of cells. Their memory properties refer to the replicative ability with high faithfulness in the case of DNA, due to the editing and error-correcting functions. They are called genetic, due to the generative and regenerative capacities, allowing self-construction and reconstruction.

Dynamic / systemic / network memories From step 6 on, proteins are active in (a) aggregation into cohesive network globules and (b) metabolic activities, including the formation of (c) self-feeding – feedback, feedforward – cycles, which configure various types of memory structures. In the later context of genetic systems, these are called **epigenetic**.

Adaptive / evolutionary systems would have a general structure of networks, where **plasticity is amplified** over that present in the components: proteins, in cells; individuals, in populations. The adaptive network systems are typically short-term, mainly ontogenetic. The evolutionary are typically long-term (e.g., the duration of species), genetic. The intermediate level, epigenetic, extends the ontogenetic mechanisms to reach a certain number – limits unknown – of generations.

Cultural evolution In humans, there are two levels of evolutionary processes: the **biologic**, Darwinian; the **cultural**, still being characterized, more complex, multifactorial. The latter reached the capacity of describing the whole evolutionary process, albeit with the limitations of the species.

Neg-entropy may be understood as the mechanism of acquisition of adaptive information through evolutionary edition (´copy-desk editing´ by natural selection) of genomic sequences. (1) Genetic variation is generated spontaneously and distributed in populations of individuals. (2) The differential reproductive abilities of individuals (fitness), along generations, is systemic, related to the whole genomes of the organisms, including all sets of variations. (3) Some variations may become more frequent, others less frequent in the process, therewith reaching possible genetic distinctions between sets or subgroups of populations along the generations. (4) New abilities, new structures and functions, including losses and gains etc. may be acquired. The key-points are spontaneity in variation, selection through whole-organism fitness, and heritability of characters, so that the eventual acquisitions can be stable along generations.

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