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A theory of evolution to understand the universe

The attempt to understand the mathematic principles of evolution brought this researcher to dig into the very root of the master evolution and find there a considerable number of physicists, philosophers and mathematicians engaged in the same noble endeavor. Although all the theories of philosophy of physics are speculative and basically attempts to find patterns and models, there is a synergy between these speculative theories and the actual scientific discoveries feed one another and ground the presentation of an almost functional draft of a model.

Most of them hold the existence of a telos, a higher goal in evolution, after which everything would converge to information and computation. The 2 most pertinent of these theories, which are going to be approached in this chapter propose development as a complementary force to evolution. The proposal is to confront these ideas with fundamental laws of macrocosmic physics such as the laws of thermodynamics and with the most fundamental natural phenomena and finally establish a comparison frame with more specialized disciplines.

Thermodynamics is, summing up, the study of the macroscopic behavior of physical systems under the influence of exchange of energy with other systems or their environment. At the very core of contemporary thermodynamics lies the idea of thermodynamic equilibrium, a state in which no macroscopic properties of the system change over time, but instead, it rearranges itself maintaining the overall equilibrium. It has often been described as a "theory of principle", a theory in which a few empirical generalizations are understood to be universal principles, which every existing thing follows. The short short short version of the Thermodynamics laws is:

The zeroth law

Two systems are in thermal equilibrium when both of the systems are in equilibrium, and they remain in equilibrium when they are brought into

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contact, where 'contact' is meant to imply the possibility of exchanging heat, but not work or particles. Extrapolating this principle to an even more abstract formula, we are talking about equilibrium among systems, isolation and contact. Also according to this law, if more than 2 systems interact, and system A is in equilibrium with system B, and System B is in equilibrium with System C, then, System A and C are also in equilibrium. The paradox in the Zeroth Law is that individuals tend not to equilibrium, but to prevalence. Therefore thermal equilibrium between systems is an equivalence relation.

The first law

The First Law states that the internal energy level of an isolated system is a constant. When the system is not isolated and the rearrangement of equilibrium forces an energy exchange with other systems, this change is equal to the energy transferred minus the work done by the system.

The second law

The Second Law says that temperature differences between systems in contact with each other tend to be in balance and that work can be obtained from this temperature difference, but that loss of heat occurs in the form of entropy (the dissipative unorganized and unwilled spread of energy) when energy is transferred. Summing, everything tends to entropy.

> "The first law says you can't win, the second law says you can't even break even."
> Charles Percy Snow at
> Physical Chemistry
> Ira N. Levine, McGraw-Hill
> 1983

Third law

If a system reaches absolute zero temperature, all processes cease and entropy comes to its minimum value. By logic absolute zero temperature would be the final entropic state.

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These laws as a theory of basic functioning of relationship among systems will, later in this paper, help the establishment of more abstract concepts, not necessarily heat exchange among systems but the basic relationship among systems in general. Other researchers, Shannon (1948), for example uses the these principles of thermodynamics in information theory. Sathe (2003) associates evolution of complex systems and information with the laws of thermodynamics as a theorized "infodynamics".

Although there are a series of particularities in every study field, the continuous development of atomic physics, cosmology and all steps of scale in between them have always pushed all fields to share similar principles.

The definition of an elegant mathematical principle for the study of physics and evolution was eagerly awaited by many researchers, which proposes a dilemma: is mathematics a result of intelligent thinking or is in the basis of the construction of the universe itself? (Chaitin 1998).

One of these theories, the IPU hypothesis holds that informational and physical processes appear, as equally fundamental perspectives on change, which draws a much clearer perspective for the design of an evolutionary model. The first ancestor of this belief is almost 4 centuries old, theorized by Descartes 1641 the qualitative dichotomy between human brain and physical brain.

It proposes that mind/body, perception/action and informational/physical as thermodynamic dualities and search for manifestations and multiple scales and time phases. As any other model proposal, IPU intends predictability and logic in both local and universal perspectives.

The "Hierarchical Universe of Increasingly Intelligent and Energetically Dissipative Complex Adaptive Systems" (Simon 1962) whereas proposes a model through which intelligence emerges establishing hierarchical structure to manage a master system that tends to entropy. In this theory, human intelligence, and humani-like intelligent creatures throughout the universe perform an important yet transient role in the hierarchical lineage of universal evolution.

Intelligence Principle hypothesis (Dick 2003) holds that the central driving force of cultural evolution is the maintenance, improvement and

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perpetuation of knowledge and intelligence, which means that culture is not a pointless human value that aims the personal evolution of man, but instead, the evolution as a general universal concept.

In another case, a reactive phenomenon described as a force opposite to entropy as a Final Anthropic Principle (Barrow and Tipler 1986). A model through which Intelligent life is a natural consequence of physical evolution.

A common argument of all these theories is the high degree of importance attributed to information as an universal fundamental. At a first glimpse, it seems appropriate, firstly because human beings are conscious observers and tend to understand it as an important component of evolution, secondly, because the duality perception action reflects itself repeatedly in many levels and moments of evolution. Finally, because there seems to be an order, a sequence of logical events in universal development. Moreover, the development of information seems to be the most clear non physical manifestation of acceleration. The connections emerge naturally.

It has been claimed that evolution as a developmental, change and complexity growth process is not an exclusivity of the biological system, the accumulation of information also frames fairly in the definition of evolution (Meyers 2009). The distinction proposed, specially by the theorizers of the EDU and EPU hypotheses, is that there might be a distinction between evolution and development, evolution as a force of variational creative and experimental production and development as the reaper of dysfunctional options and establisher of order, hierarchy and direction. According to them, our universe is not just creating riotously, but also selecting and driving towards a predestined end. That proposal would take two distinctive parts of evolutionary process, the spontaneous generation of variety and the natural selection and place them as counterpart opposite forces. Those principles are supposedly to be deeply linked to the physical structure of the universe, theoretically everything in it follows the same mathematics. The EDU hypothesis in particular proposes development to be a fractal principle reproduced naturally in every scale of evolution (universal, planetary, genetic, social-cognitive, economic, and technological), A list of opposite attributes is

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claimed to represent that duality, curiously, the same attributes are presented in a different manner in aesthetics theory as opposition between order and complexity. Order as the force that eliminates superfluous, unnecessary and excessiveness, and complexity, as the producer of variety of stimuli (Gros,

Evolution	Development	Complexity	Order
unpredictability	Predictability(statistical)	manifold	Simple
chance	Necessity	open	Closed
indeterminacy random	Determinism destined	by distance	By proximity
divergent	Convergent	by break	By good curve
segregation	Integration	different	Similar
branching	Cyclic	assymetrical	Symmetrical
reversible	Irreversible (on average)	unclear	Clear
possibilities	Constraints	anti orthogonal	orthogonal
variety/many	Unity/monism	out of balance	In balance
variability	Stability	new	Faniliar
reductionism 1st	Holism 1st		
(and holism 2ndary)	(& reductionism 2ndary)		
uniqueness	Sameness		
transformation	Transmission		
accidental	Self-organizing		
bottom-up	Top-down		
local	Global		
immaturity	Maturity		
individual	Collective		
instance	Average		
short-term	Long-term		
analysis (breaking)	Synthesis (joining)		
amorphous	Hierarchical/directional		
innovative	Conservative		
freedom	Responsibility		
creativity (of novelty)	Discovery (of constraint)		
explicit	Implicit		
practical	Theoretical		
freewill	Determinism		
period-doubling/chaos	Period-halving/order		
experimental	Optimal		
dedifferentiation	Differentiation		
stem recombination	Stem compression		
nonergodicity	Ergodicity		
innovation	Sustainability		
mind	Body		
belief (unproven)	Knowledge (verified)		

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Jochen 1983).

The instinctive human need to find opposite forces seem, after all, to have a mathematical explanation, as derivations of the gravity and entropic forces.

The distinction between these forces, which by many theorizers and for the common sense science, are implicit in the evolution, may be somehow helpful in the understanding of culture and technology in the universe and the proposal of an evolutionary model.

The almost obsessive Evo Devo intention to frame every universal phenomenon as a fractal variation of evolution and development would place even complementary concepts of cooperation and competition as developmental and evolutionary manifestations oblivious to the cooperative indirect character of competition.

From the development perspective, observations would induce the design of a model. The homoplasy, evolutional convergence would suggest that some evolutionary processes are universal, or rather, they would occur eventually in any evolutionary system. Galaxies arrange in similar ways, planets orbit stars, and moons orbit planets in the same manner in every case studied. Also in biology, equivalent morphological convergent adaptations were observed in species with millions of years apart, and are theorized to be also applicable to human cultural development. Which means that human-like creatures would have a natural impulse to develop technology, culture, language and sociological structure.

The non functional or imperfect aspects of some evolutionary beings, though, that could create a conflict inside the logic of this convergence inescapable results, would be related to the impossibility to reboot a process or to start from zero an evolutionary route. A system that was relatively adapted to an environment will either die, or mutate and thrive in a new context, but no individual or system has the possibility to start over.

Together, those two components, the predictability of convergence in a long term perspective and the unpredictability of the option trials would be at the basis of the EDU hypothesis, in other words, for the universe to evolve or develop, there must be both unpredictable creativity and predictable development, reproduction and ending to the universe.

Biological evolution has been accurately called "tinkering" (Jacob 1977). It has no foreknowledge of which strategy will be most successful. The more voluntarily pursued evolution gets, the less unpredictable it becomes. Summing, the unpredictability of trial and the predictability of results would make every evolutionary system unpredictable in a short term, but predictable in a long run.

The difference between EDU hypothesis and traditional Darwinism are that the neo-Darwinian view ignores or minimizes the importance of development, considering evolution as a simple adaptive process (Salthe 1993). Other than that, EDU simply gives a different name for the selection phenomenon, relating it to a developmental urge instead to just adaptation. Besides this semantic of the definitions is that in these new theories, evolution's final scope is the development of computer based informational system, which seems naïve considering it's human's most recent great invention, and they may have an impartial conception of the importance of that discovery.

However, even at the level of the ecosystem, it has also been observed that biological natural selection leads to increased variety or diversity of extant forms over time (Gould 2007). Furthermore, the Darwinism is a theory of biological evolution, and the EDU hypothesis proposes an universal evolutionary principle, before and after biological evolution. Modern Biological theorists hold that relationships of cooperation and competition may represent an important agent of experimentation and creation of hierarchy.

This hierarchical principle, which in nature is often manifested in a geometrical level, as a mathematic repetition of a structure would also be related to an universal principle. Replicating evolutionary processes are found across 30 orders of mass-size magnitude in biology, and may have produced also all non-biological universal complexity (Miller 1978; Jantsch 1980).

A hierarchical system is also supposed to be present in the sequence of developmental and evolutionary hierarchical events, being each one of them a consequence of its predecessor and the cause of its successor, or rather, the physical evolution triggering the chemical evolution that triggers the biological evolution, sociological, technological and so on.

The development of awareness, according to stigmatic models have a fundamental role on evolution, transforming indelibly the functioning of the adaptation process from spontaneous to voluntary, this phenomenon named “civilizing effect” of culture and technology is strongly connected to a natural tendency of evolutionary individuals to behave increasingly developmentally.

It has been discovered that evolving is an option, a choice organisms do, sometimes scarifying survival. That phenomenon has been identified comparing cells' behaviors (Kirkwood 1977,1999,2005). According to this study, the Disposable Soma Theory, germline cells (seed/sperm/egg) are highly repair/sustainment guided, but engage in little creative/evolutionary activities, except during a brief period of reproduction. Organism tissue cells, in the other hand, do the opposite choice, investing most of their energy onto creative evolutionary activities. When an individual develops complexity, there comes along the evolutionary drive. This discovery puts a new light on the evolutional intention, establishing a clear distinction between surviving and changing, survival, an egoistic individualistic activity would have lost its supremacy in living creatures behavior over evolutional collective selfless behaviors, a behavior that is not, as generally accepted, a human exclusive condition.

Both living and nonliving systems seem to make this tradeoff through their existence, having a very static set of developmental structures or seeds and a very much more ephemeron and mutational evolutionary body. At the same time, it seems that the third element in this equation is supposed to be highly relevant, the regularities of the environment supposedly influence considerably the development of intelligence and behaviors of its elements. For Smart these three elements would represent three stages of an individual's lifecycle, the seed (evo), the organism (compu) and the environment (devo). Sounds confusing as a synthesis considering that theoretically, the most evolutionary guided partition of this triad is the organism's body, not the seed. Apart that, this theorized selflessness is a successful behavior, collectively it allows the group to mutate, adapt and thrive, while the selfish survival drive would in a long term jeopardize the whole species.

The investigation on evolutional behaviors, phenomena and phases in modern particle physics led scientists to identify a certain number of phenomena an apparently non classifiable either by mathematics or physics. The hope is that as knowledge and research advance, this nineteen dimensionless constants will reveal hidden relationships among them and eventually will fit into a simpler more elegant classification. If there is an universal dimensionless constant or model, sooner or later, a Master Theory or a single equation will emerge and frame all this knowledge seamlessly (Weinberg 1993).

Although all evolutionary individuals follow a continuous adapting and developmental urge, it is outstanding how little is the control innovation and change has over developmental processes. The trend for developmental autonomy has started but technology is not yet autonomous.

> "Reflect on your knowledge of evo-devo biology, and consider how very little "control" (innovation, change) evolutionary intelligence ever has over developmental processes within any single replication cycle. It is true humans have significant rational control over technological design at present, for example, but we must not forget that technology is not yet its own autonomous substrate."
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In developmental transition, the sequence of evolutional events seem to happen always in a smaller scale. For example, the structural complexity in the universe was apparently transitioned from entropically distributed early matter, from that point, to galaxies, stars, solar systems in galactic habitable zones, to life in few planets in those zones, to highly complex living creatures, to intelligence in one isolated species, to societies, to a few cities where the technological advance happens. As much as the universe accelerates, the development seems to go all the way in the other direction, not entropic, but gravitacional. This logic would contradict Prigonine and Nicolis, thermodynamics theorists that called all complex energy using systems "dissipative structures" and considered them the central motor of universal complexification. A less minimal and more realistic evolutionary model should integrate both acceleration and deceleration, spread and gravity as the motor for evolution and the development of complex systems. Acceleration and deceleration seem to have complementary roles. The mutation process, often engaged in differentiation, spatially in biology, tends to deceleration. The more specialized are the cells, the slower they mutate, at the end, the system presents an array of terminally differentiated and highly specialized tissues.

Thinking about universal evolution, from the Big Bang to its current mature form, it is expectable a process of increasing differentiation and specialization and eventually a terminal state whether it be physically, chemically, biologically, culturally or technologically.

Earth's biology is an extreme manifestation of that phenomenon, in every level of the classification, from kingdoms to species, diversity is a continuous branching, but the mutation and innovation rate is drastically reduced at all levels, and has stopped entirely at all the older, lower levels. (Müller and Newman 2003). That might be also related to the rule of mutation on complexity, the more complex a system, the more difficult it is for it to mutate.

Diversification is an adaptive reaction. A too welcoming system inhibits mutation, as well as too inhospitable systems inhibits life in the first place. It seems that the cycles of abundance and scarcity performs an important developmental role.

Although cycles can be measured in a small watchable scale, statistics on new species generation rates and the marginal percentage of new morphologies and specializations are slower than ever, notwithstanding the fact that the number of living species is the largest ever. It suggests that biological morphologic complexity is exhausting itself. This isolated phenomenon may

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seem to be a definitive deceleration and exhaustion process, but human knowledge on overlapped cyclical events is physically limited, or rather, the deceleration may be part of a cycle that is so large in scale that humans are not capable of perceiving. Considering the trend of evolution towards consciousness, what Smart would call development, there should be a differentiation from the random character of tinkering natural evolution and an ergodic guided goal. This components apparently compound not just a gradual transition, but a relationship of alternation, which sustains both divergence and convergence, cycles, acceleration and deceleration. In a random evolutionary process, events will remain unpredictable no matter how much you sample them (Malkiel 2007). In ergodic evolution, or as Smart would call it, development, sampling of an entire phase space (behaviors, phenomena or any other available number) would lead to an average number. The natural critique to this differentiation is that, so far it has been demonstrated that both processes perform complementary roles in evolution, disenabling a differentiation between ergotic and random systems. All systems would depend on both evolutional moment. Based on that reasoning, the development of an random/ergodic model would allow us to predict large or small scale phenomena sampling from any evolutionary level (Tarko 2005). One of those possible applicability's is the comprehension of human cultural phenomena.

> “Many aspects of human sociology, culture, and art have become ergodic because human nature changes so slowly, and the number of ways to please and offend human psychology are actually limited. Art forms such as classical music, which began to greatly decelerate in rates of evolutionary creativity even in the late 1800's, thus become ergodic as there are limited ways to play the notes of the chromatic scale in a manner aesthetically satisfying to (equally ergodic) human psychology.”
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> John Smart
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Although it is clear that human culture tends to become more ergodic over time, the randomness of human cultural evolution seems to be always guided by human instinctive behavioral limitations. Human's investment in development of a very subjective and rather biologically unnecessary discipline as music, in the first place, is a strong argument to classify human culture more as a dissipative entropic activity than as a ergodic guided manifestation.

The development of culture, in a larger perspective, is not an exclusivity of human beings, any metazoan have cultural behaviors, not just genetics as part of their intelligence system, which means that cultural behavior is an evolutionary guided manifestation.

The development of non fundamentally functional or secondary behaviors would in actuality related to another principle, the fact that society and cultural behaviors, as bonding agents of a group of individuals stimulated the development of increasingly pronounced cultural behaviors. Culture persists because cultured individuals are more successful than non cultured ones because they function better in a group.

The tricky part of this cultural development though would appear as the contradictory side effects of culture and society, morality, resilience to change and to adapt, again the result of the growth in complexity. The same rule applied to living creatures would be manifested as the resistance of a developed society to mutation. (Inglehart and Welzel 2005),

Seems like this decelerative resistance to change and collapse of creativity is a sign of a larger phenomenon, the transition of phase, from biological to post-biological. This post biological entity would be able to get over randomness and collateral useless behavior and become what humans are unable to be, completely ergodic (Smart 2010).

The general perspective of this abstract evolutionary theories, observed and analyzed as a mathematical principle would ultimately guide human design, transitioning from random to ergodic, from spontaneous to predictable, dodging humans' oblivious behaviors in order to avoid trial and error, and evolve faster and better.