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Original Article

The stream of life

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In this work the processes of development appear in general and those of the embryo in particular with a new methodology. In the absence of even a theory based on the operating forces between the cells of the alive matter, to be described, quantified and even to predict the characteristics of the new alive being, an attempt is made to approach the resolution of this issue and clarified the meaning of the erroneous law of Haeckel.

The underlying philosophy can be summed up as meaning that the systems are more favourable to sustaining and maintaining life are those whose motives they repeat themselves: fractal coherent systems with Darwinism; concluding that although the alive beings constitute the most complex structures of the universe, turns out to be surprising that many of their characteristics likely to be measured could express oneself through simple allometryc equations.

Introduction

The human being has been come considering and it is still considered as the historical animal par excellence. For us, this concept must be extended to all the objects of the universe. In this sense, the closest to us, and, in particular, those who constitute our habitat, called inert and alive, they possess a common history and share common characteristics, and others that are very different. The unit of the life is the cell, an open system for his support and maintenance (reproduction) exchanges with the environment across his limiting surface area and/or energy. His association originates multi-cellular beings. Convenience of supporting in a suitable value in the exchanges surfaces, determines many of its characteristics, in particular the form of the individual [1,2,3,4].

The evolution of living beings, Darwinism [5], contemplates so much the history of the species, from the primitive cells, in the phylogeny, as the history of the individuals, in the ontogeny-embryogenesis.

In spite of being very interesting phenomena they have not raised, however, the attention that, we believe, deserve; even the basic underlying concepts are known only by the naturalists.

These phenomena consist of a series of transformations that begin with the appearance of the zygote, resulting from the fertilization of an egg by sperm [6]. The cell division of this zygote, in which cell population increases descendants, passes through a series of stages (morula, gastrula, blastula...) until populations reach with a number of descendants of about 1013, correspondents " rough way " to the formed individual.

The study of this process belongs to the embryology, being the human which one, for diverse reasons, has attracted the biggest attention from doctors and/or naturalists. As it is usually known [7,8,9,10], it consists of a detailed description of certain characteristics associated with the first embryo and with the foetus later

along its development, description associated to first embryo and foetus after a long development, description provides information but not explanation and/or interpretation, within a consistent conceptual framework. In essence, this phenomenology could be likened with the used one in the pre-scientific era.

Results and discussion

First of all, it is admitted that the material objects, which set constitutes the Universe have formed thanks to the action of certain forces that have acted along the different entities that were appearing up to coming to the current moment.

Initially, the Universe consisted of a set of particles and radiation (Figure 1), being accepted that the forces owe to the exchange of particles, since it happens for example in the game of the ping-pong, in which the ball that it goes and comes from one player to another, is what really keeps them together, the same in the case of tennis.

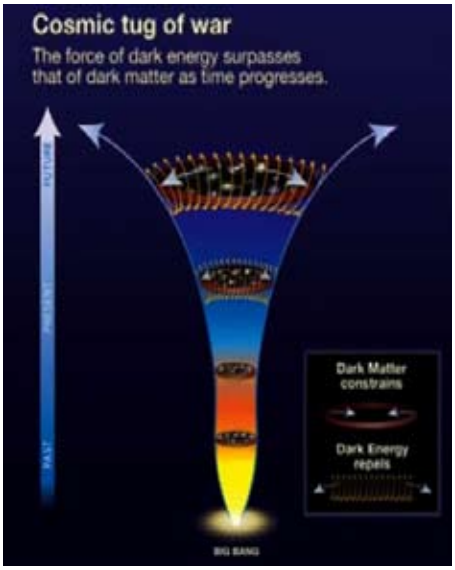

Figure 1 History of the Universe. It is the same as the history of the subject. Life is its most important product.

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The forces are the following ones (Figure 2) [11,12,13,14,15,16]: Nuclear fortress that keeps close the quarks (mainly u and d) in the nucleons, of which, the most important for us are the proton and the neutron.

The electroweak, who includes the Coulomb, called electromagnetic. This is the most important force in the context of this work and with her we will deal with it in detail later.

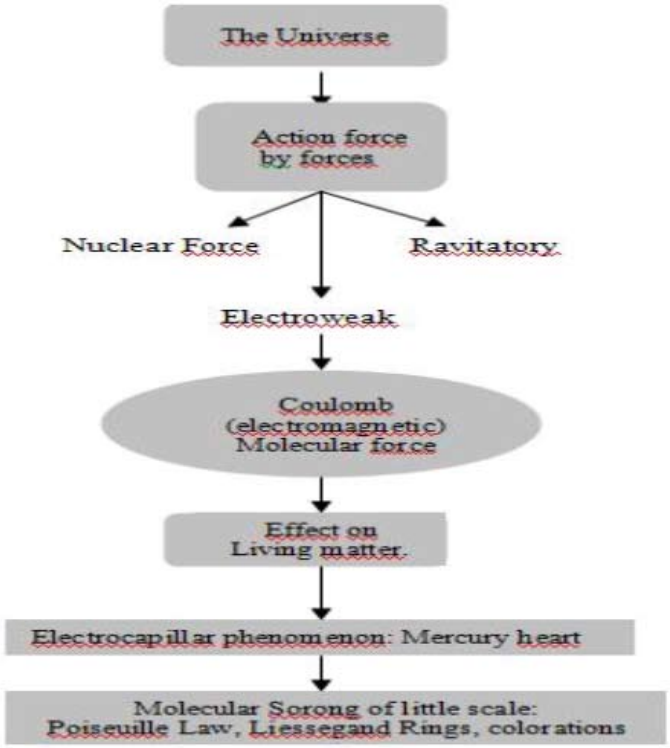

Figure 2. The matter forces. They are those who acted in the evolution of the matter, being the most important for molecular living.

The gravitational one that dominates the dynamics of the Universe, from the big masses, including super-cumulus and cumulus of galaxies, stars, up to the planets, satellites and large meteorites [17].

It is considered to be, next, the role redeemed by the forces in the different entities of the Universe and in particular those responsible for the existence of the living matter.

In the atoms, molecules and bodies of our most immediate environment, nuclear forces are kidnapped due to the shielding exercised by the negative electrons (Faraday Effect). The role of the nuclei consists of providing the necessary support for electroweak forces could exercise their function, and in particular, the Coulomb force. Let's remember that this force is formally identical to the gravitational force, only referred to the charges.

For us generally called molecular forces (calls like that because it holds for molecular dipoles) are the most important in the living matter and are derived from the Coulomb force. In the case of the water molecule it happens that, on having been asymmetric, the positive charges do not coincide with the negative and a dipole is had. By applying to dipoles Coulomb's law, there is obtained a different outcome of the case in which the charges were punctual. A big variety of phenomena are related to the presence of dipoles in the molecules, like the electro-capillaries, some as striking as the so-called "mercury heart "; in the oscillations of which the stress involved Mercury surface and the adsorption on its surface of existing ions, in an aqueous dissolution of potassium dichromate.

The most important molecules in the vital processes are the proteins [18,19,20, 21,22], which are polymers of amino acids and present themselves in aqueous dissolution generally as folded chains. These molecules are covered by a blanket of water molecules thanks to the existing bridges of hydrogen both in branches of the molecule and in the proper water molecule. A molecule of the size of a protein exhibits a surface of chemical groups and of the corresponding electrons, means, it is an electrical surface, in which an outside electron can travel abroad as a massive object does it on an eventful surface. The process of catalysis is due to the fact that some of these accidents can possess a form similar to another outside molecule, as if it were a corresponding key and lock, with the result of greatly facilitating the reaction. The vital processes involve the repetition of reactions between proteins, in which the electron is the main protagonist. The huge variety of proteins explains the big diversity of the vital processes. Moreover it is known that proteins are produced by a series of molecular processes in those who involved in DNA and RNA molecules [23,24] who form the typical genes of every species. In other words, proteins of life game in certain species should be the same as those provided by the above machinery, machinery that uses certain and particular genes. The maintenance of this connection might be related to the genetic expression.

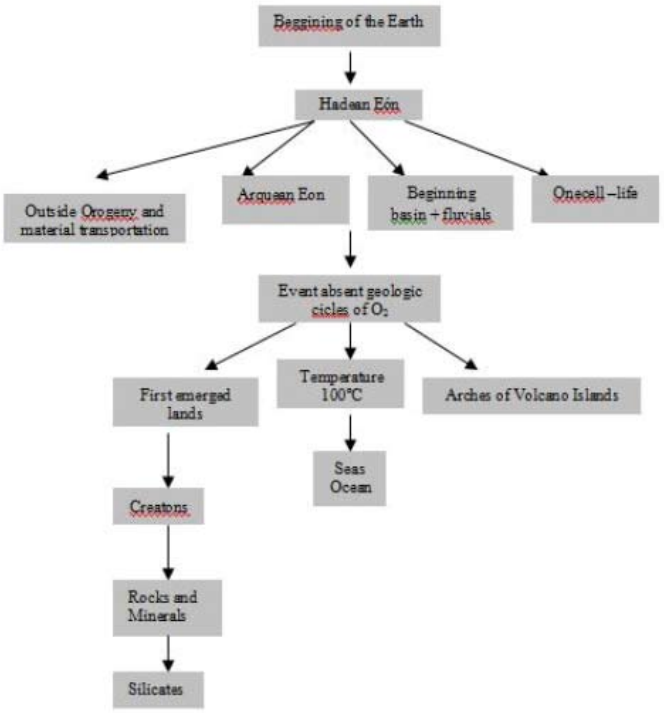

Figure 3. The flowchart contains the information of the events that shaped the Earth as result of the force operating

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The above mechanisms, which might seem like magic, are not exclusive of the living matter, but the result of certain restrictions imposed by the environment.

The work hypothesis consisted of verify that the behaviour of the alive matter is capable of being described quantitatively of same or similar way to as it is realized by the ordinary (inert) matter.

The gravitational forces formed the Earth and shaped its surface transporting its materials. We can say that they prepared a suitable settlement for the living matter.

Briefly, the events that happened in the formation of the Earth were the following ones (Figure 3).

After the Hadean eon (3800 million years ago) the Earth entered in an age of major calmness. This is the Aeon Achaean, reaching to 2.5 Ga. The events consisted of the appearance of the first land emerged (further on, creatons) and subsequently in the appearance of rocks and minerals, which major complexity reached in the polymers so-called silicates.

Figura 4. In this figure we can appreciate the system used in the evolution, both cosmic and planetary and biological: the formation of repetitive structures.

When the cooling of the planet were temperatures reached below to 100ºC, water vapour around condensed forming seas and oceans.

As a consequence of the volcanic activity, emerged the so-called "arches of volcanic islands" that further on the creatons would form, earlier or during the appearance of the prokaryotes cells (approximately 3.8 Ga ago).

In favour of the acting forces (principally gravitational ones) began the processes of external orogeny and eventually transport of materials, due to the existing level differences.

The water formed similar structures to the river, following the steps given below.

Initial movement with capillary disorder (more organized) with vein water without end with flowing streams, creeks and rivers (Figure 4).

One notice the underlying philosophy: it is the same motive that repeats itself to different scales.

In the formation of the volcanoes occurred similar mechanisms. Keep in mind that during these processes the atmosphere was not containing free oxygen. This was of great significance in many aspects.

The free atmospheric oxygen appeared approximately 2000 million years ago, that BP corresponds to the eon Proterozoic, between 2500 and 542 million years.

During such a long period of time the atmosphere changes from reducing to neutral-oxidant. The seas and oceans were reducing with important contents of ferrous ions and uraninites.

A much smaller scales, next to the molecular ones, local phenomena can appear, especially in the transport of fluids, especially water, and thanks to its big power of dissolution for the ionic compounds, derivative from its high dielectric constant. The latter processes are called of self-organizing processes geochemistry or synergistic [25].

Liessegang rings, the golden colour of some sandstone and the colorations in insects and birds are current manifestations of the same local transport processes and precipitation.

As soon as there was reached a suitable temperature, which was allowing the presence of the water in its three states, the first microorganisms appeared in shallow seas: prokaryotes cells [26,27,28,29,30,31,32,33,34]. A biotic mechanisms are ignored that the AND originated. One of us has developed a nuclear theory to explain the origin of proteins.

Considering the Stromatolites (Fig. 5) as a coastal architecture and comparing them with the previous shaped of the surface one might think that something new entered on the scene.

Eukaryote cell appeared on Earth approximately 2000 million years ago [35,36,37,38]. Between the primitive cell prokaryote and fauna ediacarense (Figure 6) (which apparently shows an authentic display of fossils) and, above all, the Precambrian, spent a large time interval, of which fossil sites are not known.

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Figura 5. Witnesses of the vital activity of the first organisms, as cyanobacterias, the stromatolites are an example of biological and geological affiliation, which would remind to us the dental plaques and in general the bacterial films.

As if it were a triumph of life on Earth we can observe tubular structures, coordinated movements, eyes, etc., that tell to us about neurons and their connections.

A structure as complex as cell eukaryote explains that it will take so long to find their habitat. To preserve this settlement it seems logical to suppose that the cell eukaryotes adopt a strategy of the repetition of mechanism that had taken so long to develop.

From a logical point of view it seems more reasonable to admit a strategy of doubling that any other one, considering that the same one is a singular characteristic of the molecules type DNA-RNA. The linkage of hydrogen, are the only ones, perhaps, that might provide the elements of the zipper (or pieces of a puzzle) that it joins two fibbers of these polymers. Long before was known, there had been called bridges of hydrogen.

Figure 6. We show here a stage of wildlife Ediacarese that can serve as an example of diverse forms that living bodies adopted in its evolution and involve into more recent floras

From this base of alive beings were formed all the others according to Darwinism [5].

The cells must absorb nutrients of their environment and expel the produced garbage. In a stationary state or quasi-stationary must be to happen that the speed of production of garbage is equal at the speed of their expulsion.

Because production of garbage is proportional to the volume and its proportional elimination to the surface, in the growth of the cell there can happened an accumulation of garbage and their poisoning [39].

As we noted, the multi-cellular organisms appeared approximately 580 million years ago with the Ediacara fauna, preceding the Cambrian explosion (542 million years ago) [40,41,42]. In these organisms the contributions of nutrients and the oxygen depend on the diffusion through the available surfaces for that.

This process is governed by Fick's first law, under which the transport speed is proportional to the surface crossed by the fluid and the gradient of concentration.

Compared with other processes of transport, particularly with the turbulent movement, the diffusion is a slow process. To reduce this slowness the living beings constructed big surfaces with the decrease of their thickness: certain worms and seaweed; hollow pipes (choral); intussusceptions [6].

In spite of the increase of the speed of absorption of the oxygen and nutrients, due to the biggest surface of exchange, the process of diffusion (from overseas), globally considered, may not be sufficient, in many cases, to satisfy the needs of a numerous population of cells (a few billion).

In this situation, the solution, almost universal, consists of adopting the strategy of the natural transport of materials, as the case of a river basin, must bear in mind the fact that for the cells it must be done through thinnest pipes, this leads us to think in the capillaries and in the laws that govern the movement of the liquids along the same ones.

These laws are explained by the contest of the so-called molecular forces. The behaviour of the movement of the liquids across capillaries obeys this type of forces and in this case one speaks about the Poisseuille law.

This law has been used by some authors to model the mammals' bloodstream and in calculating the exponent of scale in the basal metabolism [43].

In summary, the diverse and successive used strategies were the following ones:

Cellular split, mitosis, surface creation (plates and/or widespread tapes, hollow pipes), fractal surfaces, branching of matter-energy transport and transport branch of information [44,45,46].

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In the evolution of the living beings we have not mentioned the temperature of the different systems that have been appearing. It is known that the environmental average temperature (of a few degrees centigrade) was probably the correspondent to the living beings, for balance reasons. Approximately 200 million years ago the above mentioned temperature experienced a sudden change with the appearance of the mammals. Thus, there was a notable increase in the rate of speciation, as if it were a new pre-Cambrian explosion (that we can characterize for the growth of the brain and cerebellum in relation to the corporal mass). Approximately 2.5 million years ago our species appeared.

The growth

The growth is accompanied by an occupation of the available space and, as mentioned above, this occupation must facilitate the material and energy exchanges [47]. In the animals, as is the case of embryos in the egg, the available space for the growth is full with the reserve material, which is being replaced by him [48,49,50,51,52]. If the space is filled with matter, the exchanges would be limited because the diffusion across the condensed matter is a slow process (it is the molecular diffusion). This is the explanation that the vegetable develops a fractal structure that is not compact, but it has enough foliage which facilitates the turbulent diffusion in order to easily reach the nutrients the leaf surface [53,54,55].

The image of the fractal vegetable would be this one: of a trunk branches out of these, other branches and so on until the terminal bud. The success of the vegetables perhaps stems from the fact of the availability of the exterior air space and also, although to a lesser extent, the Terraqueous space, in the bosom of which the roots constitute also a fractal structure, although, as clearly as in case of leaves.

For animals available space is the egg and/or uterus, so that growth in this case is strongly constrained. Meanwhile the size of the embryo is small relative to its container, nothing is opposed to the growth, but after a while it is possible to warn the instability of the available space, which roughly coincides with the appearance of the somites. When the embryo occupies almost the whole space, growth takes place "inwards" originating, for the same causes indicated for the vegetables, fractals structures, the easiest to visualize is that of the lungs, which might be considered to be an " indoor tree " (Figure 7). The circulatory system is another fractal structure, easily reachable [56,57,58]. The fractal growth is consistent with Darwinism because their repetitive structure implies a comparatively simple genetic programming, an aspect that Dawking notes in his book " The River of Eden " [59].

If we knew the relationship between time t and mass m, means, m versus t, we would have valuable information about the history of the process, being able to deduce how they have been changing certain characteristics, such as the speed. Although not explicitly mentioned, it is supposed that these processes occurring at temperature virtually constant. Previously need to have the necessary concepts to tackle this study. The metabolism provides to us a valuable help on this matter [60,61,62].

In effect, since as everyone knows, this is the energy emitted per unit time (B Joules/sec) and is represented in the form of an allometryc equation (B=B0 ¥ mb) in which the mass of the animal is raised to the power b, whose value is about 0.7.

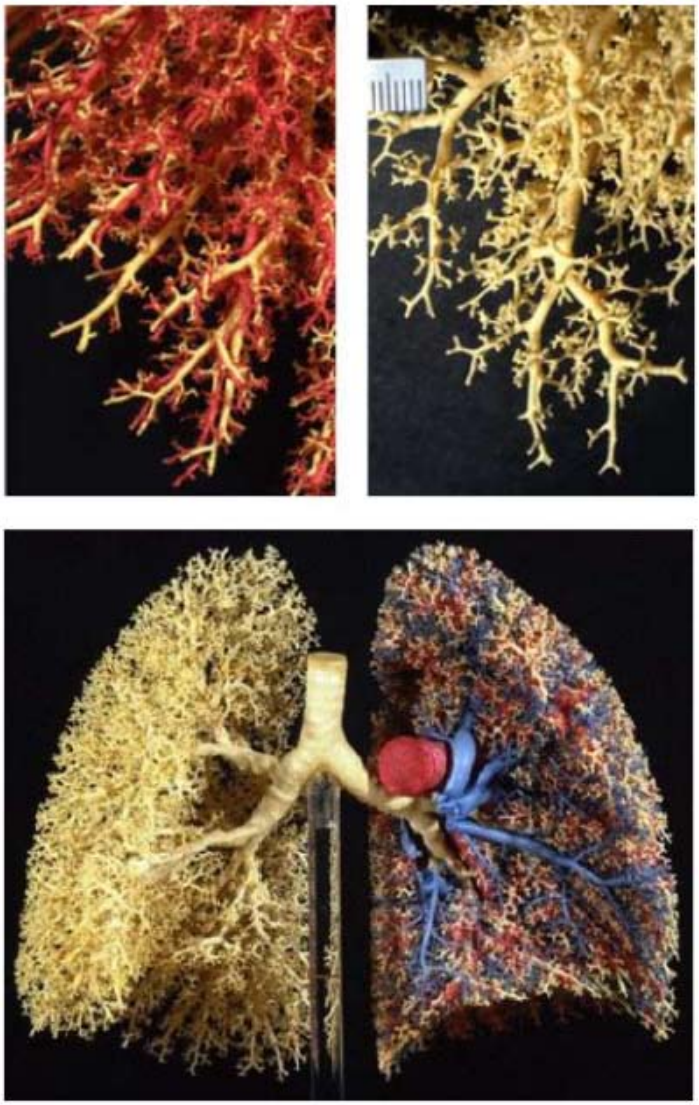

Figura 7. The splendour that vegetables show on display of fractals in the development of life, is nevertheless later to its implementation in the embryo and in the lungs of living higher.

But, what is the meaning and scope of the power b?. To solve this question it to apply the principle of conservation of energy for diverse types of animals, for example between the mammals. This principle means that anyone the animal, the energy exchanged during their average life time must be the same for the unit mass, this is, the gram. Accepting that this lifetime is given by an allometryc equation (t=t0 ¥ mc) [] 63,64, 65,66,67,68, it is verified b + c~1. The preceding hypothesis is supported by experimental measurements.

As c a value of about 0.3, we find a relationship between the time of pregnancy and the mass of the foetus at term. And more general, if we know b and c, we can consider the previous equation as if the mass were a function of the elapsed time. We are going to study experimentally this process of development.

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The information provided by the literature has been adjusted using the MATLAB [69,70]. The kindness of the adjustment can express in different ways, in accordance to statistics. The easier and more intuitive to our judgment it provides r2, coefficient of determination, in that this value represents the percentage of all values of m that fall down inside the straight line; rest of values, namely (1 – r2) % will fall down to every side of the same one, and they are called residual values. The straight line is a logarithm m versus logarithm t.

Figure 8 includes the values of the correlation coefficient and exponent c, for birds that are cited.

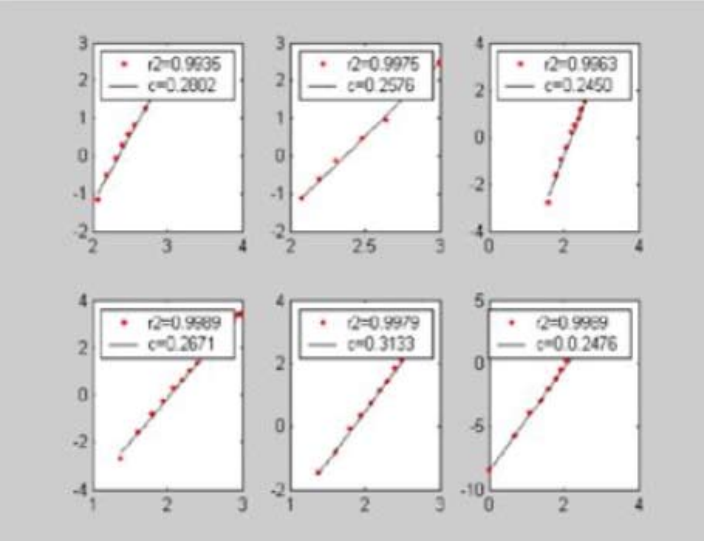

Figura 8. In the figure shows a summary of the empirical material concerning the behaviour of embryo development in birds, comparing the values of scaling exponent in the equation of life expectancy and the correlation coefficient.

Summing up, we would say that in the cases function as explained above is most suitable, if not the only one. Most notable of the previous study is the apparent absence of the embryonic period, or its difficult pursuit, from time zero onwards.

Human embryo – foetus

The information provided by the literature refers to sizes (in mm) of the embryo - foetus according to the time passed (in days). At the end of about two months, the individual values are given in grams.

With the help of Matlab we tested adjustments to equations with fewer parameters. The best equations were exponential and the potential, being the last one best suited to experimental values and extrapolated ones. The equation is d=3.106 *! 0-4 t2.747 mm (t in days). The same series of values shows that 470 mm correspond to 3100 grams. Taking to mass of the half cell to the value 6*10-10 gr, it is obtained:

N=1.1*1010 *d cells, and D=1.44*log (N) divisions.

The habit of the above equation (D versus t) indicates an initial behaviour characterized by an almost instantaneous rise, which over time decreases, as clearly indicated the presence of a curvature. Let's consider firstly what happens up to the appearance of the curvature. This behaviour is the translation of the successive processes that take place in the early embryonic development, the most important of which in a compact cell who would remember a sphere or ball of football [71,72,73]. For a single cell, the relation surface/ volume are huge, so initially problems of exchange do not exist. After the cell splits and lumpy (Figure 9) increase the surface, but not as much as if the cells do not suffer this process, so that as time increases, the relationship between the exchange surface and the volume decreases, putting in danger the subsistence due to the accumulation of residues.

Figure 9. The figure shows a morula which represents a fleeting stage crowding of cells. This structure is not sufficiently stable because the profit of obtained surface is much less that the sum of cells components, since they lose in the mutual surface.

The problem is solved thanks to the invagination, a process that consists of the transformation of spherical crowding in a cellular structure with double wall, which increases the surface values which facilitate the subsistence of the system, which passes the last crowding, called morula, to the following ones. Let's mention here that the organisms that we might call morulars, do not exist or are very rare. The slowdown that occurs then is due to emigration processes of the cells mother.

In the embryonic development the variables used are masses and/or sizes and elapsed times, whose relationship is that of the preceding expression. If instead of using these variables we make use of the small ones, they are obtained dividing each of them between the value corresponding to the final term, it happens that for same or approximate value of c, we obtain the same equation, or said otherwise, " to the same values of reduced time, the characteristics of the embryo - foetus are approximately identical ". Applied to the embryo and to the foetus they provide different results, because the embryos more closely resemble each other that foetuses between them, or in other words, the characteristics of each other for the same reduced times remain the same, they are less evident in an embryo than in the foetus, since the embryo of an elephant does not exhibit peak and the bird does not exhibit horn.

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All the above can be summarized in the sense that, for the case of the human embryo and in general to all mammals, the phenomenon of growth from fertilization to birth consists essentially of two stages, the embryonic one and the fetal one. The fact that the most conspicuous mammal should be the Homo Sapiens, suggests to think that the behaviour of mammals should be similar, which leads us to conclude that the shortened time for them should be the same, or in other words, that all embryos resemble each other (Figure 10), and therefore, exhibit similar forms, but the corresponding foetuses should be completely different.

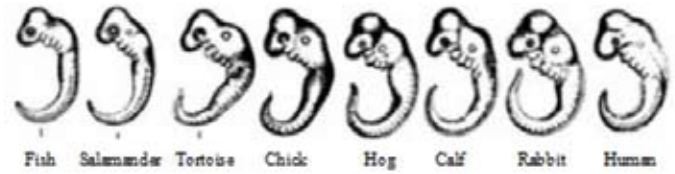

Figure 10. Note the close resemblance between the embryos to different animals, which is a consequence of the almost universal equation that governs the growth. When there express themselves the magnitudes of the values of the embryo - foetus to term. For the same values of reduced times, the characteristics are identical for all series. This is the meaning for us is the law of Haeckel.

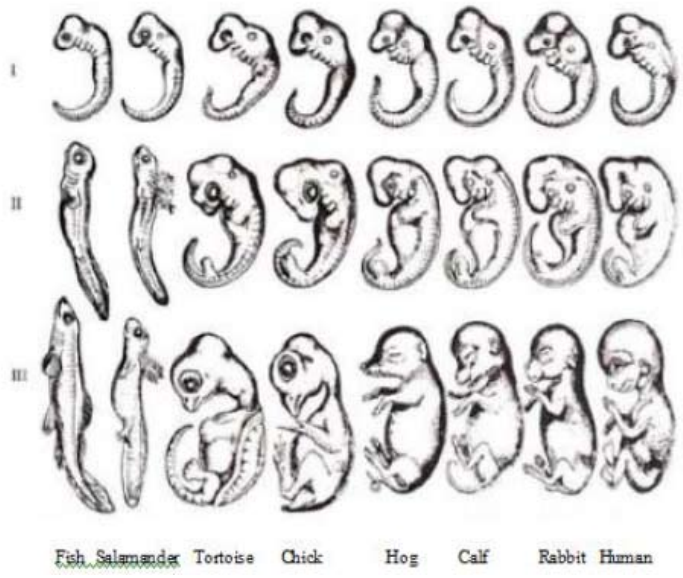

Figure 11. This is the famous series of embryos - foetuses used by Haeckel to demonstrate the law that takes his name.

Macroscopically, considered the differences between foetuses in contrast to embryos similarities. The extraordinary thing about this behaviour is explained by the emigration of so-called mother cells, means that as soon as was finished the phase of embryo, cells have take different ways to form different tissues: a peak in birds, a trunk in an elephant and a mouth in the Homo-Sapiens. Who dictates the indifferences cells of the mature embryo, the orders so they "know" which way to go so that no elephants with peak or mice with horn? The response is an evolution and genetic expression [74,75,76].

Haeckel's Law

Comparing somewhat arbitrarily embryonic forms of some species (Figure 11), Haeckel enunciated that "ontogeny recapitulates phylogeny", whereby the first one refers to the growth and development of an individual and the second one to the evolution of the corresponding species. In other words, every successive stage in the ongoing development of an embryo - foetus, corresponds to an adult forefather of the history of the considered species. Referring, for example, to species homo-sapiens, and considering that in the evolution of species it has been preceded by fish, amphibians and reptiles, the different forms that are displayed embryonic development, according to Haeckel, the adult forms of these species and in the same order [77].

Although the mentioned theory has been discredited by the modern Biology, its influence has been quiet remarkable, having been even extended to other fields. For our part, we believe that the concepts introduced on the synchrony and diachronic have very much in common, not only in language, but in other fields, such as the periodic table [78] in which the electronic structure of an element (synchronism) summarizes (diachronous) the set of all previous structures.
Our position on this matter is Haeckel's law does not exist.

These must be, in any case, some important concepts related to Haeckel's to extrapolate the big resemblance between the embryos that he studied.

Assuming the current doctrine about the Universe and the universality of the operative forces (primary magnitudes), introduces a new way of coherent description for all the objects formed in the course of evolution and in particular for the correspondents to our most next environment. This methodology globalized and integrated, helps to clarify very important knowledge about the Universe in general and of the Earth, as the only settlement closer to life phenomenon, in particular.

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