THE ORIGINS OF THE UNIVERSE

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TRANSFORMISM: FROM INERT MATTER TO LIVING MATTER

Talking about transformation when discussing evolution is very appropriate because before it was coined as “evolution”, it was called “transformism.” Evolution, as we call it today, is in fact, the quintessence of transformation, imagination and creativity.

Einstein once said “*Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand.*” Other scientists, on the other hand, argue that in order to be thorough, science requires imagination. This is very interesting because science is quintessentially thorough, and yet it needs to be nurtured and fueled by our imagination, which is what gives us drive to explore new lines of research, as well as providing the tools we need to posit theories.

Human beings belong to the history of life, which in turn belongs to the history of earth, which belongs to the history of a galaxy, which belongs to the history of a universe. So when discussing the origins of humankind, to what exactly are we referring? The origin of human life? The origin of mammals, animals, the living world? Earth? The Solar system? The universe?

John C. Mather was able to date the origin of the universe back to somewhere between 13.9 and 13.5 billion years ago, leading to an average of 13.7 billion years ago. That is when the first traces of matter were detected, and from that point forward, everything was transformation. First came unstable matter, which was very warm, dense, particularly

bright, and most importantly changing, or transforming if you will. This matter presents a unique specificity: as soon as it exists, it transforms, in order to become increasingly complex and increasingly organized. This is all the more interesting in that it took place in a universe determined by stable physical rules. Had it been otherwise, we would not have been able to understand it, or identify these transformations. The physical laws of our world have not changed for the last 14 billion years, and yet its matter has continued to transform and evolve toward increasingly complex and better organized forms.

The history of the universe begins with matter, somewhat inappropriately called inert matter, which progressively went from quarks to nucleons (particles), then to atoms and molecules, each of which is more complex than the other. Our world is characterized by an obsession for change. As soon as the sufficient conditions are present, the transformation occurs. Matter first appeared in large “pancake” structures, which then divided into galaxies, which in turn divided into stars. The dust from stars which was not able to agglomerate led to the formation of comets, asteroids and planets. And so, Earth is only one small planet, dust, which was not linked to the Sun, and was formed at the same time as the solar system, i.e. some 4.6 billion years ago. In the beginning, Earth was not protected, and thus was bombarded by objects from the sky: meteorites, comets, etc. Comets brought water, and other objects brought gas. As Earth also produces gas, this created an atmosphere, and over time, the water became oceans. Both the oceans and the atmosphere were trapped on Earth due to gravitational forces of mass and distance between our planet and the sun. This is the reason our planet has water, a protective atmosphere, and what makes it so specific. To date, we have not found anything similar, although we probably will someday.

Starting 4.6 billion years ago, and from the moment oceans were generated, which took some 500 million years, the same obsession for transformation continued in the water and on Earth. And so, molecules became increasingly complex and organized, to become cells: clusters of molecules with a membrane which, for the first time ever, presented a wonderful, more complex and organized characteristic: they were able to reproduce. This transition from inert matter to living matter led to a paradox: inert cells became increasingly organized, leading to living matter which is increasingly diversified, and yet increasingly controlled.

KINGDOM ANIMALIA

Living matter began on Earth 4 billion years ago in water, with unicellular organisms. Around 2 million years later, these had evolved to multicellular organisms, later diversifying into animals and plants, approximately 1 billion years ago. Around 5.35 million years later, vertebrates, i.e. beings with a spine, developed underwater. These living beings, initially referred to as chordates, represent a form of progress because the spine is an internal skeleton, thereby more flexible, and acts both as a spring and a shock absorber. This means that life existed and evolved under water for 3.5 billion years, only emerging some 500 million years ago.

Life left water, or more accurately, water left live. Because of gravitation, water underwent regressions, and so animals who were in the water were exposed to air, and either died or adapted. In adapting, fundamental changes occurred. Vertebrates, for example, developed lungs in addition to gills in order to survive in this new environment. These amphibian beings marked the beginning of the life of terrestrial vertebrates on Earth. Over time, some of these became reptiles, and some of these reptiles became mammalian reptiles, i.e. mammal-like reptiles. Around 200 million years ago, they became oviparous mammals, and 100 million years later they became placental, viviparous mammals, thereby ensuring greater protection of their progeny. This reflects the notion of progress which is inherent to transformism, and is the driving force of the transformations undergone by these beings. Life, nature, the universe, present an obsession for change. Change does not always occur because all the conditions are not met, but as soon as the conditions are met, transformations occur to preserve life. The same can be applied to plants. They started by reproducing through spores, which were very fragile and sensitive to humidity. Some 400 million years ago, these spores became seeds, which are more resistant to humidity. Here, we observe nature's obsession to preserve the species. Of course, some species do not succeed in their transformation and become extinct.

Life continued its evolution, and led to the emergence of primates. This category encompasses humans, pre-humans, great apes and monkeys. Primates are placental mammals, whose first traces date back to 70 million years ago. One of the key components of transformation is adaptation: the ability to adapt to new, changing conditions. A living being can only

live within a given environment. The first primates were insectivores, but they found an ecological niche, or in other words, a part of the environment which was available to them. This environment comprised the first flower trees, and therefore the first fruit trees. So, these placental mammals adapted to arboreal life, and as a result of this adaptation, they adapted to the combined consumption of flies, as they had done in the past, and of plants, brought to them by this new environment. This marked the origin of the primates from which we descend. Among other things, this also led to the development of the opposable thumb, and therefore the ability to grasp, and their eyes became more centered in order to gain depth perception and see in three dimensions, a vital skill when living in trees and jumping from one tree to another. In order to facilitate tree-climbing, what used to be claws became nails, and the pectoral girdle was developed. The structure of the eye socket also evolved in such a way that they developed the necessary cell layer to see colors, which they needed to eat fruit.

These primates evolved throughout the world in different ways in Africa, Asia and America, and among these primates, some 10million years ago, new primates appeared: hominidae, the last common ancestor of chimpanzees and humans. Of course, this means that from an anatomical, physiological, ecological, ethological and genetic point of view, chimpanzees are the closest beings to us. From an evolutionary viewpoint, the descendants of these common ancestors lived in different environments. Some lived in a dense, rainforest environment; and others in a much more uncovered environment, made of less dense forests and prairies; the former being more humid, and the latter dryer. The root causes of transformism are often environmental, and that is probably why pre-chimp and chimp descendants developed in ways that corresponded to adaptation to the forest. Contrary to common belief, it is not that chimps did not evolve and that humans did. It is simply that they did so in different ways, based on their environment. Pre-humans, living in a more open, aerated spaces, with a greater variety of grasses, in which pastures started appearing, reacted and adapted to their environment by standing up. This is both extraordinary and extravagant. Other animals, such as monkeys or bears, for example, are able to stand for a short period of time to defend themselves, to see further or to carry what they need, but such a behavior is exceptional and temporary. Pre-humans on the other hand walked all the time, became

bipedal and continued to climb. We were able to identify and analyze this evolution thanks to “Lucy.” The analysis of her remains revealed there was a transition phase from the common ancestor and first pre-humans which were fully bipedal and climbed. This meant that in the history of evolution after insects, primates adapted to a diet of insects and fruit, and then, pre-humans adapted to fruit and roots.

Between 3 and 2 million years ago, a new climate change occurred. The land became increasingly dry. The drought was so significant that the animals from these ecosystems were forced to find alternative solutions to adapt to these new conditions. Trees and pollen progressively disappeared, going from a ratio of 0.4 at 3 million years to 0.01 at 2 million years, with trees surviving only in valleys which were more humid. In order to adapt to this state of things, nature, with its obsession with for preserving its species, transformed and adapted.

It may seem surprising that all these evolutions were successful, and evolved in the “right” direction. In fact, geneticists explain that when a crisis occurs, rather than triggering one mutation in an attempt to adapt, there are 100 or 200 mutations at the same time, in order to guarantee greater success at survival. Some animals transformed successfully, and others — mastodons, for example, despite many evolutions — did not. Hominids found five solutions, each of which was adapted to a specific ecological niches. At the time, there were five large bio-geographical regions, which differed slightly from one another. In the Afar region, i.e. North-Eastern Ethiopia, at the crossroads between Ethiopia, Somalia, Eritrea and Djibouti, they developed stronger skulls and teeth to adapt to their new vegetarian diet. In Eastern Africa, i.e. southern Ethiopia, Kenya, Tanzania and Malawi, this evolution was two-fold. They became more powerful and stronger, in order to be more physically dissuasive because they were more vulnerable and more exposed; and at the same time, they developed a very large dentition to eat plants which had not existed before, or at least not in abundance. In Southern Africa, the solution is similar to that of Eastern Africa but not identical. In the rest of southern Africa, the Gracile solution is observed, with the emergence of *Australopithecus Africanus* and *Australopithecus sediba*: they were still characterized by a small brain, and were good climbers and walkers. The fifth solution, found in Eastern Africa, is human beings. They were bipedal, better walkers and

runners, they stopped climbing, simply because there were fewer trees, and their dentition transformed in order to adapt to an omnivorous diet, which they were forced to adopt due to the lack of plants. This, in turn, had a positive impact on our evolution, as it provided necessary proteins for the development of the brain, which became larger, more complex, and better organized. As the brain grew, the distribution of the lobes changed. Since there was not enough room for the brain to continue expanding, the brain started creasing. This meant it was better irrigated, and helped enhance the brains processes.

What the study of evolution has taught us is that human beings were born from a need to adapt to a climatic change. It is as simple as that. Just like horses, giraffes, dogs or elephants, we came into being arising from a natural need to transform with the obsession of ensuring the survival of the species. This development led the human brain to go over a threshold which had never been attained before, and by corollary, the brain reached a level of reflection never attained before.

CULTURAL EVOLUTION

When life appeared, molecules went from being inert matter to living matter, and with more cerebral matter, we went from being living matter to thinking matter, which changed things dramatically. For the first time, human beings were able to reflect on what they knew, they became aware of their own knowledge. This meant they were able to anticipate, think ahead, and to have an impact on their environment. For example, using two natural shapes, they were able to create a third shape, thereby making the first deliberate tool ever made, and for the first time, human beings could have a voluntary impact on their environment.

Of course, this ability to reflect on knowledge, ourselves and our environment also meant we became aware of our mortality, which immediately led to the exponential development of our intellectual, ethical, esthetic, cognitive and spiritual abilities. This means that within a natural environment, which had existed for 14 billion years, a new, cultural, environment emerged and would, ultimately, have a retroactive effect on our natural environment. For example, in Melka Kunture, a site in the upper Awash valley near Addis Ababa, a series of human habitations were found,

which were home to Homo Habilis, Homo Erectus and Homo Sapiens successively. Put in schematic terms, the analysis of the successive layers of the land unveiled that an initial group “A”, which can be dated back to 1.5 million years, produced a “Culture A.” The subsequent group, “B”, i.e. the product of a biological transformation, continued to make tools “A.” This demonstrates that our cultural environment was born, but that it developed at a slower rate than that of natural evolution. Gradually, Group “B” produced a culture “B.” This was followed by a group “C”, which produced a culture “B”, followed by another group “C” with a culture “C”, then a group “C” with a culture “D” and a culture “E”, and so on and so forth, thereby indicating that while biological evolution continued at a steady pace, cultural evolution grew insidiously, and as natural evolution stagnated, cultural evolution evolved exponentially. Now, we are able to stop natural evolution in its tracks, thanks to our cultural evolutions. For example, doctors and medications mean we are able to postpone our natural evolution and prolong our natural life.

All these scientific observations were discovered through the impetus of imagination. In order to grapple with the world we live in today and imagine the future which awaits us, it is important we understand some key elements. Over billions of years, we went from being inert matter to being living matter; we are descendants of the living world, which is 4 billion years old; we came from water some 500 million years ago. We belong to the reign of animals, are very close to apes and are still subject to the laws of biology. The transformations in our brains and thought processes are the product of natural transformations triggered by nature’s obsession for the conservation of species, and the individual, which is the specificity of the thinking world. This means: we are a small, average sized-mammal, on a small, average-size planet around an average-size star, in an average-size galaxy among billions of galaxies and suns. However, in this immensity, to our knowledge, we are the carriers of the most complex part and element of matter produced over the last 14 billion years. So, we are nothing and yet important, until one day, our imagination leads us to discover something bigger or smaller.