



“Searching for order at all levels”. Antonio Lima-de-Faria (July 4, 1921 – December 27, 2023)

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Professor Antonio Lima-de-Faria was our friend and, in a sense, a teacher. Despite our different fields of study, this master of scientific thought has deeply influenced both of us.

Dr. Stefano Serafini came to know the work of Antonio Lima-de-Faria when he was just a teenager thanks to a disseminative article by the late Italian geneticist, Giuseppe Sermonti. Lima-de-Faria’s elegant vision of a universal order at all levels of nature opened his eyes to the consistency of patterns, forms, and function throughout the mineral, vegetable, and animal realms – a concept that has influenced his work in urban studies.

Prof. Tatyana Turova met Antonio Lima-de-Faria on a museum tour of the Royal Physiographic Society (Lund). He was 95. When Antonio came to know that she is a mathematician working in probability, the discussion went straight to a critical analysis of the concept of randomness. That conversation kept going over the years.

Professor Emeritus of Molecular Cytogenetics at Lund University (Sweden), Antonio Lima-de-Faria was a scientist of rare character. He had the innate gift of courage and the ability to tackle big problems despite dominant opinions. He was rigorous and tenacious in his method, and he had an immense knowledge and a sharp rationality.

Antonio Lima-de-Faria defined himself as “a surviving dinosaur” to both of us. He was a magnificent old man – but that “dinosaur” had been ahead of his time since the beginning of his career. This was a constant. In the early 1960s, a multinational company discreetly requested him to develop a futuristic agrifood bioengineering program. This is the current reality of the genetically modified organism.

Known to the scientific world as a pioneer and one of the most relevant exponents of molecular cytogenetics (his 1969 *Handbook of Molecular Cytology* is a classic) – not to mention author of over 200 research articles and influencing monographs – Lima-de-Faria became a member of some of the world’s top scientific societies. He also taught in some of the most prestigious universities. He received awards and recognition for his extraordinary activity. These included the appointment as Knight of the Order of the North Star

by the Swedish King and as Great Official of the Order of Santiago by the President of Portugal. He held scientific consultancy positions for governments and institutions, including the European Space Agency, the United Nations Educational, Scientific and Cultural Organization, and the World Bank Group. He never stopped working and studying. In fact, he focused on the molecular organization of the chromosome until the end of his long life.

Despite all of this, his endeavor was not always understood. His famous book, *Evolution without Selection: Form and Function by Autoevolution* (Elsevier, 1988, translated into Russian, Japanese, and Italian) is not only fundamental and revolutionary but also a case of sociology of science. This book, which advanced the current trend in molecular biology, even branded him as anti-evolutionist. Such a tag limited the essence of his work to a mere attack against natural selection – “a parlor game to explain life,” as Giuseppe Sermoniti would say.

Rather, this treatise, based on his vast physical, chemical, crystallographic, botanical, and zoological expertise, proposed to overcome the concept of natural selection. It downsized the role of genes and chromosomes in the architecture of living things through a plethora of biological forms that came directly from physical constraints. His self-evolutionism united the biological and inorganic worlds. This echoed Aristotelian and Goethean intuitions of morphofunctional homologies, that is, a sort of “non-genic kinship” between the spin of the ultramicroscopic electron, the shell of a *Limnaea*, and the spirals of immense galaxies.

Indeed, selectionism (identifying natural selection not as a contributing cause but as the main engine of biological development) is the major methodological obstacle to the recognition and explanation of Lima-de-Faria’s morphofunctional homology. This is the true protagonist of his book. An order crosses and defines the subatomic, chemical, and physical worlds on all of their scales through progressive and deterministic channels. The form of *Chitoniscus feedjeanus*, traditionally explained as a classic example of the mimetic imitation of leaves, has a precedent in the arrangement of the crystals of pure bismuth. The same structure appears in the patterns of chlorite crystals, several vegetal hooks, the shells of ancient ammonites, or goat horns. The bird’s-eye-view of an estuary, the branches of a tree, and the vascularization of a mammal follow a single dendritic development pattern – so much so that their images, once reduced to the same size, are difficult to distinguish. Constant chemical commonalities actually underlie these and countless, more apparent natural oddities. Now, selection is not only powerless to account for them but also logically incompatible with any attempt to explain them. Like all

strong theoretical systems faced with a fact that is refractory to integration, selectionism ignores homology. And when it cannot help but deal with it, it defines it as mere analogy. This then relegates it to that metaphor of annihilation, which is accidentality.

Therefore, demolishing selectionism in biology was the necessary premise for developing a theory of self-evolution, towards which Lima-de-Faria has led us with a firm, methodical hand. Indeed, he deploys a set of images and observations that are rarely rivalled in modern scientific literature.

Beyond classic studies on the subject, from D’Arcy Thompson (*On Growth and Form*, 1917) onwards, there is no doubt that recent molecular biology has continued to confirm with ever greater evidence the importance of elements that are complementary to classical theoretical genetics in the formation of living organisms. Lima-de-Faria had already begun to indicate and systematize these elements 40 years ago in *Molecular Evolution and Organization of the Chromosome* (1983). In fact, as the author himself recalled, *Evolution without Selection* is the consequence of those premises once applied to evolutionism.

The last writing of Antonio Lima-de-Faria, printed in this very issue of *Caryologia*, develops and complements his marvelous treatise *Praise of Chromosome “Folly”: Confessions of an Untamed Molecular Structure* (2008). This masterpiece continues the great tradition of scientific giants such as Schrödinger and Feynman (authors that Antonio Lima-de-Faria highly regarded) talking to the public about the most advanced theories in a clear way. It is written with such wit and humor and such an elegant reference to art that any reader with a natural sciences or mathematics background, having read the first sentence, will not stop until the last. The book summarizes results on chromosome research and offers directions and ideas for further studies. It clearly confirms that understanding evolution requires a deep knowledge in not only chemistry and physics, but also mathematics – especially when it comes to the atomic level.

Long discussions with Antonio Lima-de-Faria of one the authors began soon after *Molecular Origins of Brain and Body Geometry: Plato’s Concept of Reality is Reversed* (2014) was published. In an intriguing manner, this work unveils and explains the emergence of body patterns in animals by tracing them to the origin of the brain. For Antonio Lima-de-Faria, “geometry” manifests an “utter simplicity coupled to rigorous order that underlines the phenomenon.” He does not use the language of mathematics, as he was not trained in it. However – even if this may sound paradoxical for a non-mathematician – his search for order, for “a common denominator”, for a unifying theory, make them akin to fundamental mathematics.

Remarkably, already in his early nineties, Antonio Lima-de-Faria completed an extensive analysis of the structures and functions of living organisms on a molecular level. He then created a new book, *Periodic Tables Unifying Living Organisms at the Molecular Level: The Predictive Power of the Law of Periodicity* (2017). This truly fascinating work provides a new perspective on the relations between matter and energy. Its logical systematic approach links different levels, from atoms to macromolecules to organisms.

As Lima-de-Faria stated, his books do not give ultimate answers and immediate solutions to the posed questions. On the other hand, readers are invited to use the tools, methods, and ideas that he generously expressed in his late works. “Order allows variation but imposes in the same time a canalization that is patent in what we call evolution, being that of galaxies or of living organisms.”

Antonio Lima-de-Faria was almost 100 years old when he released his last book, *Science and Art are Based on the Same Principles and Values* (2020) – something he had thought about “for 30 years.” It was his scientific testament, encompassing his life-long love for art, beauty, and truth. There, as a “lonely wolf howling in the immensity of the night,” he launched a straightforward warning:

“At present a wave of obscurantism is spreading over Western countries affecting both science and art in a deadly way. (...) Modern technology has been most successful in transforming our daily lives and in allowing us to conquer outer space. These impressive achievements have, to a large extent, made us dumb, making it difficult to perceive the danger that lies ahead. Hence, there is a pressing need to bring forward the original sources in which, leading scientists and renowned artists, explained the principles that they followed in their discovery of novel phenomena and in the creation of unique works of art. It turns out that both types of minds speak the same language. There is a basic denominator that unites the human endeavor.”

Lima-de-Faria’s works are jewels for scientific and aesthetic minds. The beauty of Nature absorbed him completely, and he devoted himself passionately to it. He was an admirer and a true connoisseur of the arts, music, and ballet. He was a passionate gardener and loved roses and the fragrance of flowers. Antonio Lima-de-Faria was a man of enlightenment, dedication, will, and truth. With his gentle and generous attitude towards anyone around him, Antonio Lima-de-Faria radiated love. He knew what happiness is (“What is Happiness?”, *Journal of Biourbanism*, IX, 2021).

Antonio Lima-de-Faria is an endless source of inspiration and admiration for us.