Foresight

How the Chemistry of Life Reveals Planning and Purpose

Marcos Eberlin

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Description

Learn about jumping insects with real gears, and the ingenious technology behind a power-punching shrimp. Enter the strange world of carnivorous plants. And check out a microscopic protein machine in a bird's eye that may work as a GPS device by harnessing quantum entanglement. Join renowned Brazilian scientist Marcos Eberlin as he uncovers a myriad of artful solutions to major engineering challenges in chemistry and biology, solutions that point beyond blind evolution to the workings of an attribute unique to minds—foresight.

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Endorsements

I am happy to recommend this to those interested in the chemistry of life. The author is well established in the field of chemistry and presents the current interest in biology in the context of chemistry. I am happy to recommend the work.

—Sir John B. Gurdon, PhD, Nobel Prize in Physiology or Medicine (2012), Co-Founder of The Gurdon Institute, University of Cambridge

An interesting study of the part played by foresight in biology.

—Brian David Josephson, PhD, Nobel Prize in Physics (1973), Professor Emeritus of Physics, University of Cambridge

It's my pleasure to highly recommend the book *Foresight* by Dr. Marcos Eberlin as excellent and instructive material. This book provides masterful information about teleology, an exciting and prominent scientific field that provides irrefutable evidence of foresight in nature. The arguments raised in the book are convincingly supported by incontestable and previously published experimental data, much of it gathered from prestigious scientific journals. Dr. Marcos Eberlin brilliantly makes use of his expertise, achieved in more than twenty-five years applying mass spectrometry in assorted areas such as biochemistry, biology, and fundamental chemistry to outline a convincing case that will captivate even the more skeptical readers. Eberlin's book demonstrates that the currently available scientific knowledge increasingly points to the existence of a supreme being who carefully planned the universe and life. This breakthrough will revolutionize science in the years to come.

—Rodinei Augusti, PhD, Full Professor of Chemistry, Federal University of Minas Gerais, Belo Horizonte, Brazil

Despite the immense increase of knowledge during the past few centuries, there still exist important aspects of nature for which our scientific understanding reaches its limits. Eberlin describes in a concise manner a large number of such phenomena, ranging from life to astrophysics. Whenever in the past such a limit was reached, faith came into play. Eberlin calls this principle 'foresight.' Regardless of whether one shares Eberlin's approach, it is definitely becoming clear that nature is still full of secrets which are beyond our rational understanding and force us to humility.

—Gerhard Ertl, PhD, Nobel Prize in Chemistry (2007), Former Director of the Department of Physical Chemistry, Fritz Haber Institute of the Max Planck Society, Berlin, Germany

Marcos Eberlin, one of the best chemists in the world today, has written a must-read, superb book for anyone considering what indeed science says of the universe and life.

—Dr. Maurício Simões Abrão, Professor at the University of São Paulo Medical School, São Paulo, Brazil, Editor-in-Chief of the *Journal of Endometriosis and Pelvic Pain Disorders*

Why would a man stand against an army? Perhaps the man is crazy. Perhaps he wants to commit suicide. Or just maybe the man has some very powerful weapons. Prof. Marcos Eberlin is this man. In *Foresight*, Eberlin challenges an almost universally accepted theory. What are his weapons for attacking such a strong fortress? It is your choice to agree or not with his evidence and arguments. You may in the end conclude he is right, or that he is indeed mad. But to understand Eberlin's side and to be intellectually honest, this is a must-read book.

—Brenno A. D. Neto, PhD, Professor of Chemistry, University of Brasília, Brasília, Brazil, Associate Editor for *RSC Advances*, a journal of the Royal Society of Chemistry

Foresight fascinated me by its breadth and depth of knowledge of all things biological. Drawing from his specific field of chemistry, Marcos Eberlin reveals the astonishing ways that the chemistry of DNA and RNA make them perfect for their tasks. If you ever wondered in

biology class why RNA uses ribose and DNA uses deoxyribose, or why RNA uses uracil and DNA thymine, Marcos Eberlin's book will tell you why, and how their perfect suitability for their purpose is a remarkable example of foresight. As Eberlin's detailed description reveals, the chemistry and biology of DNA and RNA come together in an interlocking puzzle that goes click when it's all in place. The fit, and the foresight required to build it, are incredible. Eberlin's book also deals with life on the organismal level—everything from our sense organs to sexual reproduction and the wondrous structure of a bird's egg. None of his foresight arguments are based on a lack of knowledge, or a God-of-the-gaps-mentality. They are based on positive knowledge of what the biochemistry and physiology of life require.

—Ann Gauger, PhD, Senior Fellow, Center for Science and Culture, Co-Author, *Science and Human Origins*

In his newest book, *Foresight*, award-winning and prominent researcher Prof. Marcos Eberlin cogently responds to crucial questions about life's origin, using an arsenal of current scientific data. Eberlin illustrates his points with varied examples that reveal incredible foresight in planning for biochemical systems. From cellular membranes, the genetic code, and human reproduction, to the chemistry of the atmosphere, birds, sensory organs, and carnivorous plants, the book is a light of scientific good sense amid the darkness of naturalistic ideology.

—Kelson Mota, PhD, Professor of Chemistry, Amazon Federal University, Manaus, Brazil

Foresight is for those willing to challenge themselves with a new perspective, for free people who dare to go beyond scientific dogmas. Marcos Eberlin's book is a journey through the evidence in chemistry and biology for the indispensable role of foresight in the origin of life and the universe, presented by the author in an easily understood and engaging way.

—Daniela de Luna Martins, PhD, Associate Professor of Chemistry, Fluminense Federal University, Rio de Janeiro, Brazil

Foresight provides refreshing new evidence, primarily from biology, that science needs to open its perspective on the origin of living things to account for the possibility that purely natural, materialistic evolution cannot account for these facts. The book is written in an easy-to-read style that will be appreciated by scientists and non-scientists alike and encourages the reader to follow the truth wherever it leads, as Socrates advised long ago.

—Michael T. Bowers, PhD, Distinguished Professor, Department of Chemistry and Biochemistry, University of California Santa Barbara

Dedication

To my loving wife Elisabeth, my daughters Thais,
Livia and Niina, my son Nicholas,
and my grandchildren Leah, Claire, Theo, Luca and Thomas,
who have followed or, I deeply trust, will follow
the evidence where it leads. And above all, to the "Foresighter."

Contents

1. Foresight in Life

Biology is in the midst of a gold rush of discovery. At my previous academic institution, the University of Campinas in São Paulo, Brazil, I ran the Thomson Mass Spectrometry Laboratory for twenty-five years. There my team and I delved into many areas of chemistry, biochemistry, and medical science that until recently were still too new to have names—everything from proteomics, lipidomics, and mass spectrometry imaging to petroleomics and bacteria fingerprinting.

My research, along with my role as president of the Brazilian Mass Spectrometry Society and the International Mass Spectrometry Foundation, has brought me into contact with other leading researchers in Brazil and around the globe. And when we come together at conferences, the excitement is palpable. Thanks to a cluster of breakthrough technologies and techniques, almost every week reveals some new wonder in the biological realm.

Some of these discoveries yield new medicines or medical techniques, such as the abundantly awarded cancer pen recently developed by my daughter Livia. Others give engineers new ideas for inventions in the burgeoning field of biomimetics. Still others have no immediate practical application; they're just revelations of beautiful biological ingenuity—scientific discovery for its own sake.

All of this new knowledge is exhilarating in its own right. At the same time I am now convinced that many of these discoveries, taken together, point beyond themselves to something even more extraordinary. This new age of discovery is revealing a myriad of artful solutions to major engineering challenges, solutions that for all the world appear to require something that matter alone lacks. I will put this as plainly as I can: This rush of discovery seems to point beyond any purely blind

evolutionary process to the workings of an attribute unique to minds—foresight.

And yes, I know: We're told that it's out of bounds for science to go there. We will take up that claim in subsequent chapters. But regardless of where you ultimately land on the question of what conclusions science should or shouldn't allow, and whether or not you ultimately affirm that this gold rush of new evidence points to the workings of foresight, I urge you to inspect the evidence. Curiosity may have killed the cat, but it's done wonders for the scientific enterprise.

The many and ingenious examples uncovered in recent years are so numerous they could fill many large volumes. The pages that follow highlight only a small fraction of the total. But that fraction is filled with marvels. We'll look at everything from insect gears and power-punching shrimp to carnivorous plants and a protein machine in the avian eye that may harness quantum entanglement, allowing birds to see Earth's magnetic field.

We begin, however, with an example that appears mundane—though only at first glance.

A Membrane and Its Channels

Life thrives in our diverse planetary environment, thanks in no small part to the many ways Earth is fine-tuned for life. But Earth can also be extremely hostile to life. The oxygen molecule (O_2) is, for instance, essential to life; but only a life form that can efficiently wrap and transport the devil O_2 exactly to a place where it can be used as an energy source would benefit from its angel side. Otherwise, O_2 becomes life's greatest enemy.

Rupture the membrane of a living cell, exposing it to the air, and you will see the great damage O_2 and a myriad of other chemical invaders can do to a perforated cell. Death would be swift and sure. From an engineering standpoint, then, it was essential that a way be found to protect the cell, life's most basic unit. The solution was clever: The cell was surrounded by a strong chemical shield, from the very beginning.

It is often said that a solution always brings with it two additional problems, and a cellular membrane shield is no exception. A simple shield could indeed protect the cell interior from deadly invaders, but such a barrier would also prevent cell nutrients from reaching the inside of the cell, and it would trap cellular waste within. Small neutral molecules could pass through the membrane, but not larger and normally electrically charged biomolecules. A simple shield would be a recipe for swift, sure death. For early cells to survive and reproduce, something more sophisticated was needed. Selective channels through these early cell membranes had to be in place right from the start.

Cells today come with just such doorways, specialized protein channels used in transporting many key biomolecules and ions. How was this selective transport of both neutral molecules and charged ions engineered? Evolutionary theory appeals to a gradual, step-by-step process of small mutations sifted by natural selection, what is colloquially referred to as *survival of the fittest*. But a gradual step-by-step evolutionary process over many generations seems to have no chance of building such wonders, since there apparently can't be many generations of a cell, or even one generation, until these channels are up and running. No channels, no cellular life.

So then, the key question is: How could the first cells acquire proper membranes and co-evolve the protein channels needed to overcome the permeability problem?

Even some committed evolutionists have confessed the great difficulty here. As Sheref Mansy and his colleagues put it in the journal *Nature*, "The strong barrier function of membranes has made it difficult to understand the origin of cellular life."[1]

And that's putting it delicately. Somehow, a double-layer membrane—flexible, stable, and resistant—needed to be engineered, one that would promptly and efficiently protect the cell from the devastating O_2 permeation, remain stable in aqueous acid media, and ably handle fluctuations in temperature and pH (Figure 1.1). To do all these tasks, the

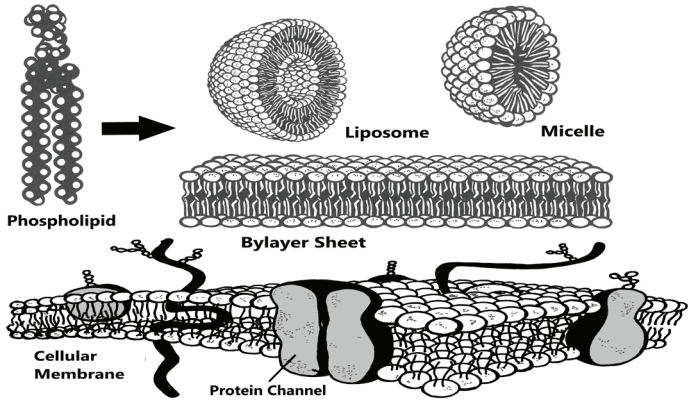

Figure 1.1. The double-layer membrane encloses our cells. It is very flexible, but it also has high mechanical and chemical resistance. The many intricate membrane components and the capacities it possesses that are required to keep a cell alive make the appearance of foresight in the original assembly of the membrane all but overwhelming.

cell's molecular shield also would need a mechanism to sense changes in temperature and pH,[2] and react accordingly, adjusting the membrane's chemical composition to handle these physical and chemical changes.

For instance, as Diego de Mendoza explains, bacterial cells "remodel the fluidity of their membrane bilayer" by incorporating "proportionally more unsaturated fatty acids (or fatty acids with analogous properties) as growth temperature decreases." The process is known as homoviscous adaptation. Cell membranes, in other words, can initiate a series of cellular responses that react to a change in environmental temperature.[3]

If you were to bid this demanding, multifaceted job out to the most technologically advanced engineering firms in the world, their top engineers might either laugh in your face or run screaming into the night. The requisite technology is far beyond our most advanced human know-how. And remember, getting two or three things about this membrane job right—or even 99% of the job—wouldn't be enough. It is all or death! A vulnerable cell waiting for improvements from the gradual Darwinian

process would promptly be attacked by a myriad of enemies and die, never to reproduce, giving evolution no time at all to finish the job down the road.

It seems, then, from all the biochemical knowledge we now have, that the cell membrane's many crucial requirements had to be foreseen, and delivered on time, for the earliest cells to survive and reproduce in an aqueous environment.

And that's just the beginning of the foresight apparently required to deliver a membrane good enough to make cellular life viable. Such a membrane wall, with its many intricate abilities, also requires a veritable Swiss Army knife of biomolecules. And happily, these were provided in the form of an amazing class of exquisitely designed biomolecules: the phospholipids (Figure 1.2).

These biomolecular pieces had to be just right. To construct a chemical shield sophisticated enough to allow cells to survive and thrive, there seems to be no substitute for phospholipids. Sometimes I come across articles in journals such as *Science* and *Nature*[4] theorizing about simpler, primordial cell membranes made of "rudimentary" molecules such as fatty acids. But such flights of fancy ignore key chemical details of what's needed to render cellular life viable. Once we confront those details, we

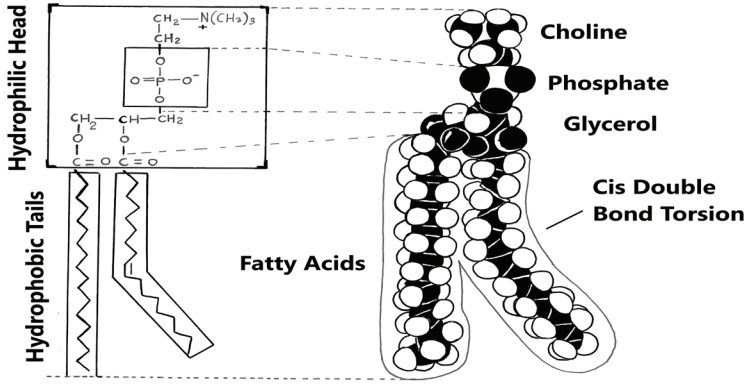

Figure 1.2. This simple caricature only hints at the phospholipids' complex molecular structure.

find that no other biomolecule appears able to sustain life by fulfilling the many intricate roles phospholipids perform.

The structure of a phospholipid can be divided into two main regions that possess quite opposite physical-chemical properties: The head is polar and water-loving (hydrophilic), while the tail is non-polar and water-hating (hydrophobic). This dichotomy of "tastes" is crucial, because it allows for a marvelous trick: In the presence of water, these biomolecules automatically arrange themselves so as to form round, double-layer structures (Figure 1.1) with all the polar heads lining up next to each other and the elongated non-polar tails packed very tight.

Attracted by finely tuned chemical forces, two such monolayers come together so that the tails from both layers will also contact each other in a tail-to-tail arrangement. This automatic 3-D, multi-component packing ensures that the water-hating tails are hidden from water while the water-loving heads on the outer and inner surfaces are exposed to water. Water is therefore placed inside and outside the cell, but is helpfully expelled from the interior of the phospholipid membranes that enclose the aqueous cells.

Again, it's as if a causal power with foresight anticipated this need and engineered a perfect solution.

Phospholipids

The cell membrane needs to be elastic but at the same time also mechanically and chemically resistant so that it can continuously protect the cell from its fluctuating surroundings. Fortunately for life, phospholipid bilayers are flexible, but also highly stable, being resistant to mechanical stress and pH and temperature fluctuations.

So, how are all these properties obtained? By means of a fine, dynamic balance of the various physico-chemical properties of the many molecular constituents of the wall. (If the following explanation is too technical for your taste, feel free to skip down to this subsection's final paragraph. The summary there will give you enough to go on.)