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Evolution Unraveled

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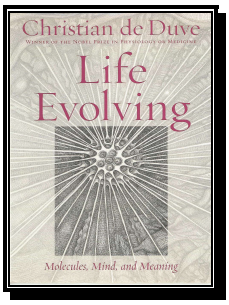

By Christian de Duve
Oxford University Press (2002)

Life evolving. What comes to mind? Perhaps, natural selection, fossil records, the emergence of *Homo sapiens*. DeDuve gives his work this title, and indeed discusses these evolutionary matters, but goes beyond the scope of how we normally think of evolution in its scientific connotation. The breadth of the title does not begin to encapsulate the breadth of the subjects he addresses. De Duve extends the discussion of evolution to give his comprehensive view of how biology permeates all aspects of humankind, not only physiologically, but historically, ethically, and philosophically. It is our evolution into complex, smart beings that has allowed our species to evolve many facets of life, such as culture, technology, or religion, which sets us apart from all other life forms on earth. Taking on the task of tracing our evolution into its current phase (and even speculating on how it will proceed), De Duve gives an all-inclusive trip of the evolution of life from mere molecules to tremendous, multi-cellular, multi-faceted organisms.

Although De Duve extends the discussion of evolution into many disciplines, he certainly spends the first eleven chapters of *Life Evolving* explaining the scientific bases of evolution. As many theories exist of how the basic components of cells actually became organized into cells, themselves, De Duve argues in favor and against many of these theories, and eventually states his opinion on how he thinks important events took place. For example, a controversy exists of the order in which RNA and ATP emerged. To the lay audience (and even those who are familiar with the functions of RNA and ATP), this seems like a complex area of study. But De Duve eloquently and logically states that if RNA, indeed, came first, then it would have given rise to ATP, meaning that the information stored in RNA arose before the energy that is actually required to construct RNA. The absurdity of this idea points to the notion that ATP preceded RNA. With the use of such logically constructed arguments, De Duve is able to reach audiences of all sorts of educated backgrounds.

In these first eleven chapters, De Duve is also able to give the reader a lesson on the functions of many pieces of cellular machinery. In taking us on a journey of how molecules formed amino acids, which in turn formed proteins, which led to the emergence of RNA, DNA, and eventually whole cells, he gives himself a context to explain important processes such as DNA replication, transcription, translation, mitosis and meiosis, and how these all emerged during the course of evolution. It is in these chapters that DeDuve pays homage to the biochemists who have striven to unveil the deepest secrets yet known in molecular biology: "There can be no attempt at understanding life without the language of chemistry. This is all the more true because even biological information depends on chemistry. Unfortunately, few of us are familiar with even the basic elements of chemistry, in spite of the leading role of chemical industries in our technological civilization" (12). It is De Duve's intent to explain the evolutionary nature of cellular processes with at least minimal chemistry background, in order to delve relatively deep into basic molecular biology without completely unraveling and oversimplifying the concepts for his lay audience.

De Duve continues to spend time on the "invisible" evolution of prokaryotic bacteria, archaebacteria, and eukaryotes, in which he explains the idea that the emergence of these cell types most likely occurred "more or less simultaneously." This is perhaps one of the more surprising stages in De Duve's evolutionary history, in that it is widely known how drastically different these cell lines eventually became (as they are characterized today). Understandably, eukaryotes did not suddenly develop the endoplasmic reticulum, the golgi apparatus, or even a nucleus overnight, and this is not what he is getting at. What De Duve fails to explain is if their origins actually occurred "somewhat simultaneously," how is it that three distinct types of organisms could have risen at the same time and all survived without out-competing each other? How, at the birth of these individual organisms in which they were most closely related, were they not dependent on the same nutrients or fuel that ensured their survival? Until this point, DeDuve so thoroughly demonstrates how the development of processes such as transcription or translation was evolutionarily possible and plausible according to environmental conditions that existed at the time. It is here that he could have given a better idea as to how the emergence of these distinct types of cells was favorable or even probable at the time he proposes.

De Duve naturally moves on to the organization of cells into multicellular organisms, and the progression of these organisms into more complex forms through the mechanism of natural selection. This logically leads to the discussion on primate evolution and the emergence of intelligent life due to the development of the brain, and how *homo sapiens* were able to participate in new kind of evolution due to their newly acquired mental capabilities. After this mini-lesson in paleontology, De Duve begins to address the ramifications that the development of the brain had on the evolution of life on earth. Although at times he delves into subjects that do not seem explainable in biological context, he is able to connect science to just about any facet of human existence.

Perhaps the most compelling commentary De Duve gives on the brain is its mysterious manifestation of the intangible operations of the mind. Neurobiology has developed a very solid understanding of the nature of the neuron, how it uses neurotransmitters, how action potentials are created, and how neurons are grouped in the brain. It is even known which parts of the brain are responsible for certain brain functions, such as memory, verbal usage, and auditory processing. But the greatest mystery left to unravel is how neuronal activity allows us to carry out specific mental

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functions. How does the firing of specific neurons allow you to understand this sentence? Certainly there are regions of the brain that are active in helping you to do so, but how do the neurotransmitters, axons and dendrites and their interactions all translate into what we call our *mind.* As this is a widely pondered question seemingly far from being tackled, we will not hold De Duve at fault for not being able to explain this one.

What he does answer with great eloquence is how the brain allowed for evolution to take place in a new playing field. Certainly genetic evolution is still operating, although we are not able to see its effects in our time frame. But it cannot be ignored how the lives of human beings have become far advanced since the emergence of the species, itself. One enormous area of complexity is that of technology, that has progressed from the discovery of fire, to the construction of simple machines, to the implementation of agriculture, the use and production of electricity, and so on. Other inventions include development of belief systems, logic, moral systems, and culture. The driving force for all of these developments that set humans apart from all other forms of life is our use of language. No longer did information have to be inherited genetically, over thousands and millions of years. The next generation could immediately gain what the previous possessed in their brain through verbal report, and put it to use and adapt it to make significant advancements. It is our brain capacity and physiological make up that allows us to intellectually evolve at rates that are *many* orders of magnitude greater than organisms without it.

What does this intellect have in store for humans, and for all other life on earth? Our pool of biological knowledge led us to discover how life works on the molecular level, which now gives us the power to alter the genetic makeup of organisms, perhaps to the extent of which we cannot see the ramifications. Genetically modified foods seem to be economically beneficial at this point in time, but in the long run will more harm come than good? We begin to weigh ethical issues of cloning, especially with humans, and with stem cell research, which at times involves the creation and sacrifice of a human embryo, and therefore, a human life. Our vast knowledge of chemistry and physics has led us to discover ways to produce energy through the use of fossil fuels and nuclear power, but will this ultimately bring humans and other life forms to their downfall by destroying our own environment? And because our scientific knowledge has led us to the understanding of how life has evolved, we begin to question an extremely deep-rooted, defining aspect of humankind, the existence of God. The very knowledge we have acquired thanks to our extraordinary development of the brain that has led us to become the earth's most complex organism, biologically, psychologically, emotionally and intellectually, now leads us in directions that can either further our development, or debunk and dismantle everything that has guided us to this phase of human existence. Accomplishing an extraordinary feat in describing evolution in the context of many disciplines, De Duve marvelously depicts evolution in biological terms, and flawlessly relates its impact to all realms of the existence of humankind in *Life Evolving*.