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Summary of *Life Itself*

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People have often explored the possibility of life outside the realms of earth. The key issue that is in focus in the book *Life Itself* lightly touches and deals with this possibility. However, what the author, Francis Crick, is genuinely concerned with is the origin of life on earth. Throughout this book, he presents another possible explanation for the existence of life. Crick's theory is a polished version of Panspermia called Directed Panspermia. Panspermia was a theory suggested by the Swedish physicist Arrhenius who proposed that life was "seeded by microorganisms wafted in from space" (Crick 15). However, other scientists did not find the idea at all convincing and criticized him by stating that the spores could not have managed the journey without being tarnished by radiation. Directed Panspermia circumvents this criticism with the help of an additional clause that seeds could have traveled in the "head of an unmanned spaceship sent to earth by a higher civilization which had developed elsewhere some billions of years ago" (Crick 15-16).

In a very particular and organized manner, Crick first provides the reader with the background information in order to set a platform to build his argument further. Crick believes that one must know about the Big-Bang theory because the knowledge of the origin of the universe furnishes a framework of the conditions under which life originated. The Big-Bang theory states that the universe at first was just a big, massive, expanding fireball that cooled as it grew bigger. Crick mentions that around that time, the temperature dropped to a point at which stable atoms began to form and the formation of stars and galaxies began to occur due to condensation of matter. "The earth, with its inner core of iron and the solid skin of lighter elements near its surface, was built from accumulated ashes of earlier stars" (Crick 35). In a concluding statement, Crick declares that it would take an interval longer than one billion years until life originates.

The author adherently believes that the core answer to the problem of the origin of life lies at the molecular and atomical level. Perhaps this, Crick proposes, is the reason why scientists all around take special interest to learn and explore organic chemistry. He informs the reader that living bodies are comprised of organic materials that underwent structural changes due to the ever-changing temperatures billions of years ago. With the changing structural pattern of the organic molecules, life evolved by natural selection. However, Crick mentions that a common thread still links each species in nature. For example, the key molecules (such as nucleic acids, proteins, and polysaccharides) play the same role in all organisms. Another astonishing, unifying principle is that proteins, the root of the metabolic apparatus of the cell, are made of a particular set of twenty amino acids that exists in all organisms. Even the genetic code is transmitted using the same four-letter language. All of these similarities, Crick articulates, hint at a common, underlying plan.

Though numerous people set out on the quest to find the origin of life, few know life itself. Crick confesses that it is really difficult to succinctly describe life by words. However, understanding life provides insightful clues to the possible reason for the existence of life today. Crick retorts that the presence of life in various, complex forms has made the act of drawing a line between what is living and what is nonliving nearly impossible. However, as Crick delicately strands words together, there are certain conditions that a thing has to meet in order to be characterized as a living being. "The system must be able to replicate directly both its own instructions and indirectly any machinery needed to execute them" (Crick 56). With utter disbelief Crick retorts that it is quite perplexing to many why the copying process is such an essential requirement. However, he brings awareness to the fact that vast differences in the genotypes (the assortment of genes in a living being) between species or members of the same specie lead to competition. Only the individual who is able to replicate and pass on the needed, random mutations, improvements to the genotype that ultimately bring about favorable changes in the phenotype (the traits the being displays to the world) that make the organism finely tuned to its environment, is able to evade extinction. Crick ties the whole thing together by making the connection that this nature's way of promoting traits that allow an organism to adapt better to its surrounding is what Darwin called natural selection—the basic cause of evolution.

After enlightening the reader about the deep importance of replication, Crick digs deeper into the topic. The DNA and the RNA, he fervently insists, play an active role in the process. However, the importance of the RNA and the DNA, Crick suggests, pales in comparison to the role proteins play in the human body. In conclusion, to give a purpose to his extensive effort to explain replication, Crick states that by understanding the complexity of the process of replication, the proposed idea of life originating in a primitive soup appears to be an unlikely and miraculously slow one that could not have sprung forth in such an elaborate manner, so as to produce a higher race capable of thinking in less than $2^{½}$ billions of years.

The origination of life in a primitive soup becomes even more unconvincing, Crick suggests in a promissory tone, when one takes a look at the "chemical and physical conditions of the primitive earth" (Crick 72). It is common knowledge, he points out in a smug manner, that nitrogen (N_2), oxygen (O_2), water vapor (H_2O), and carbon dioxide (CO_2) essentially make up the atmosphere today. However, this, Crick explains, was clearly not the case billions of years ago. The primitive atmosphere, he enthusiastically narrates, contained an abundance of oxygen which was produced by the partition of water (H_2O) caused by the exposure of water to the ultraviolet rays that could freely reach the earth's surface since the ozone layer (O_3) that blocks these harmful radiations today was absent then, into its separate fractions—O_2 and H_2. Surprisingly however, the atmosphere, Crick notifies, was not rich in hydrogen (H_2) because the temperature back then was so high that the weightless hydrogen atoms escaped directly into space. He tells the reader that an atmosphere profuse with hydrogen and deficient of oxygen is said to be reducing while an atmosphere with deficient proportions of hydrogen and profuse fractions of oxygen is said to be oxidizing. According to Crick, a reducing atmosphere provides proper conditions for the growth of organic molecules which could be a source of raw materials for the primitive creatures. But since it is a commonly accepted detail that the primitive atmosphere was oxidizing, due to a lack of raw materials, life could not have originated. Thus, Directed Panspermia, Crick reinforces, could be the likely solution to the problem of the origin of life

Crick boldly admits that people might treat the theory of Directed Panspermia as science fiction. However,

one, he pleads, must take into consideration that unlike many science fiction novels, Directed Panspermia is supported by concrete principles of contemporary science. The theory after all could be a possible answer to the problem of the origin of life on earth.

I find Francis Crick to be a very enigmatic, open-minded, logical, flexible, tolerant, and humble person. Though his theory might require a longer leap of faith, Directed Panspermia is clearly a well- grounded, firmly built theory that could be the possible reason for the existence of life today. If one cannot fulfill Crick's modest request to consider his theory to be more that just science fiction then I seriously doubt if that person is anything but a self-centered prick. *Life Itself* was a very delightful book to read because it brought forth the crucial nature of scientists to look for all possible causes or solutions to a problem.