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Note on Molecular Evolution and the Various Levels

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Perspective

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ABOUT THE STUDY

There are various stages of molecular evolution. The fundamental level is concerned with the processes that resulted in the formation of bioelements. This level is devoted to cosmology and astrophysics. Only through these disciplines can we hope to explain the formation of elements from elementar particles and the evolution of heavier elements from the cloud of hydrogen, deuterium, and helium that comprised the Universe after the "big-bang" some 18 billion years ago (assuming the "big-bang" is a true model of the Cosmos' origin). This level of molecular evolution also contributes to emphasising the physical Universe's fundamental unity. In the nuclear furnaces of the first generation stars' interiors, the original light elements were fused into heavier ones. When these stars died, much of their constituent elements were returned to interstellar space *via* supernova explosions, material shedding following gravitational collapse, and so on.

This cosmic debris was then incorporated into second generation heavenly bodies, such as planetary nebulae, resulting in the formation of astronomical systems such as our solar system. As a result, the heavier elements inside the Sun (which is not a first generation star) and the solar system's constituent atoms must have come from other stars that have long since decayed into white dwarfs, neutron stars, or black holes. Similarly, the main bioelements of terrestrial life, such as carbon, nitrogen, oxygen, phosphorus, iron, sulphur, and so on, which are components of all extant living organisms, including man, were cooked inside a massive star billions of years ago.

We now have some of the most important chemical components of life, and the next stage of research will concentrate on the evolution of the first cells. Two laboratory models are currently attempting to describe the organisation of biomolecules into functional cells. Oparin's coacervate model is the first, and Fox's microsphere model is the second. Oparin exploited the fact that polymer-rich aqueous solutions spontaneously separate into coarcervates polymer-rich colloidal droplets suspended in a water-rich medium. Coarcervates can be given primitive metabolic functions by providing them with an enzyme. When a substrate of that enzyme is added to the medium, it tends to diffuse into the droplet, where it may be metabolised and "waste products." Fox's model is the other. He demonstrated that varying amino acid mixtures can be polymerized into polypeptides known as proteinoids simply by heating the dry amino acid mixture in a nitrogen atmosphere at about 160°C for 18 hours. Many properties of thermal polyaminoacids are similar to those of modern proteins, such as limited compositional heterogeneity, the inclusion of non-amino acid groups, weak but definite enzyme-like activity, and so on. In saturated solution, they form microspheres. These are 10 m wide cell-like spheres with a thick shell-like proteinoid membrane. Microspheres exhibit some characteristics of existing cells, such as budding and heterotrophic growth, conjugation (material transfer from one microsphere to another), and so on. It is widely assumed that these microspheres are internally ordered. Thermal co-polymers organised into microspheres can produce a wide range of biochemically active substances, including enzymes.

The acquisition of cellular mechanisms for information storage and transmission, resulting in true reproduction, should be the focus of the next stage of molecular evolution. From there, one enters the realm of prokaryotes, followed by the evolution of eukaryotes from prokaryotes in response to the presence of free oxygen in the terrestrial atmosphere as a result of photosynthetic bacteria's action, and finally the evolution of multicellular organisms from unicellular organisms. These are, however, questions beyond the scope of this introduction. The following points should be stressed:

1. All extant life on Earth originated from a single common ancestor because there are no significant differences in the molecular biochemistry of any of the known life forms.

2. Living organisms can be classified as what Orgel refers to as CITROENS: Natural Selection Evolves Complex Information-Transforming Reproducing Objects.

It is critical for living organisms (whether we call them CITROENs or not) to be able to store, process, and transmit information. Biological information can be transmitted intracellularly and intercellularly, and it appears that Nature prefers chemical messengers for this purpose. Hormones are chemical messengers, and studying their evolutionary origins reveals one of the most fundamental aspects of life's evolution.