Evolutionary theory
Debating the origins of our DNA

For over a decade, Mr Shaojie Deng of Chongqing Municipal Bureau of Planning and Natural Resources, China, has been formulating and more recently presenting his new evolutionary theory to the academic world. Over time his thought processes too have evolved with his most recent manuscript centring around the stable complex model as an explanation for the evolution of enzymes and functional biomolecules. In his most recent manuscript, Deng details how the model provides an explanation for key evolutionary concepts and calls for current evolutionary theory to be expanded and alternative viewpoints taken on board.

It is widely believed that DNA was formed from RNA through the mechanism of reverse transcription. But what evolutionary mechanism drove this? Deng believes the stable complex evolution model is key in understanding the origin of genetic systems, the origin of metabolic systems, and the origin of polymers (enzymes that synthesise DNA or RNA). So what is this model, and can it give us the answers to these questions?

WHAT IS THE STABLE COMPLEX EVOLUTION MODEL?
Firstly, the stable complex evolution model is a structural model of evolution, meaning structural or physical forces are thought to be driving evolutionary change. The fundamental concept of this model is that biomolecules form stable, tight, and complementary complexes enabling them to carry out their function. Interactions between molecules are complementary, meaning their interaction improves or helps the other. Such interactions occur in all biological processes including those within genetic systems (transcription and translation) as well as metabolic reactions, for example, receptor-ligand interactions. Deng proposes the amount of complementary area between molecules dictates their binding affinity. This binding affinity provides the means needed for conformational (or structural) change of the complex and it is through conformational change that certain molecules signal information. These tight complementary interactions are proposed to be at the heart of phenomena such as intrinsic selectivity of life and self-organisation, discussed later.

TIGHT BONDS AND ENZYMES
Enzymes are needed for cellular function because they speed up essential chemical reactions by binding and converting substrates into molecules or product. The tight binding of an enzyme to the active site of its substrate causes conformational changes in the enzyme itself. This conformational change is needed for catalytic reactions to occur, therefore such reactions are regulated by this binding. This close or tight bonding between molecules is essential for the functioning of many molecules and its evolution was crucial in the origin of life. Deng believes the stable complex evolution theory can explain the evolution of enzyme substrate complexes. He proposes that local mutations (possibly away from the active site) were, in part, responsible for such evolution by altering the enzyme substrate complex active site itself, ultimately affecting its catalytic ability. Mutations may also be responsible for the evolution of a new enzyme for a substrate and, in some cases, the active site of a pre-existing enzyme.

POLYMERASES: LIFE’S ESSENTIAL BUILDING BLOCKS
In his recent manuscript, Deng states, ‘Life originates from polymers.’ Biopolymers are produced by cells and engineered by enzymes using building blocks of amino acids, fatty acids, and sugars to form larger molecules. These polymers therefore form the foundation of the complex biological systems we know today, with polymerase enzymes helping to assemble DNA or RNA from these polymers. Considering their importance, Deng argues that any theory about the origin of life must be able to explain how polymerase enzymes evolved. He suggests his stable complex evolution model can explain the origin of these polymers and complementary interactions, providing an explanation by which functional molecules evolved.

The model does not detail the evolution of RNA but rather assumes its prior existence. What the model does provide is an explanation for the mechanism of reverse transcription in the evolution of DNA from RNA. For reverse transcription to occur, polymerase enzymes are needed for making our genetic material, DNA and RNA. Polymerase enzymes are vital for making our genetic material, DNA and RNA. This demonstrates that through its prior existence, DNA was able to explain how polymers came to carry out their function.

DNA polymerases create DNA molecules by assembling nucleotides

Figure 1. Polymerase enzymes are vital for making our genetic material, DNA and RNA.

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LOOK AT THESE NEW GENES!
Many studies indicate that the process of reverse transcription has enabled the evolution of new genes and other parts of the genome, such as gene regulatory sequences including promoter regions and coding sequences. In primitive cells, Deng proposes that proliferation of gene regulatory sequences could have been a key to the development of genes. Another school of thought is that new genes can form when stress induces the formation of enzymes to help relieve that stress. On a separate note, the human genome consists of non-coding sequences that don’t code for amino acids but maintain other roles in the genome. Various studies suggest these non-coding sequences can themselves evolve into coding sequences and subsequently new genes.

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THE CO-EVOLUTION OF GENETIC AND METABOLIC SYSTEMS
Deng believes the evolution of the genetic and metabolic systems is closely linked and that they evolved together in a synchronised manner over millions of years. He proposes the stable complex model that could help explain both these evolutions. With a high number of enzymes required for the functioning of the metabolic system, Deng suggests that the evolution of this system would have increased the quantity of enzymes and proteins in cells which in turn prompted the development of the DNA genetic system. Conversely, it is possible that
The stable complex evolution model provides a fresh perspective in understanding the evolution of our genetic systems.

The stable complex evolution model is central in this selective force acting at the molecular level during evolution. Deng believes that stable binding provides functional stability, biological systems can also gain complexity. In fact, stability is needed to gain complexity. Regarding the intrinsic selectivity of life, further and applied?

The stable complex evolution model provides a fresh perspective in understanding the evolution of our genetic systems. Deng advocates for the expansion or modification of his theory. The stable complex evolution model offers an explanation for the fundamental characteristics of life: the origins of the genetic and metabolic systems, whose evolution he proposes are intrinsically linked.

Adapting to Survive
Adaptive evolution refers to adaptations of an organism to ensure they survive and thrive in their habitat. There are two principles of adaptive evolution, namely the function-based principle and the principle of cell selection. The former refers to the inclination for cells to maintain a stable function and a balance with the environment. The principle of cell selection proposes that cells maintain this stable function by acquiring mutations. Because cells want to maintain balance with the environment, any change in the environment can cause instability in cell function tipping it into a stress state. To counteract this instability and reinstate stability, the cell may select a mutation that enables this. Changes in the environment may therefore be one of the main driving forces of evolution and therefore cells need to adapt to survive. A real-life example of adaptive evolution can be found in a population living at high altitude with low-oxygen conditions. Research at the Tibet Institute of Medical Sciences discovered such populations develop a new protein called haemoglobin X. This protein is not present at birth but evolves to enable them to adapt to their low-oxygen environment because it improves oxygen use in the body. Over a prolonged period under low-oxygen conditions, haemoglobin X could become integrated into the genetic structure to ensure survival of the species.

Self-Organisation, Functional Stability, and Intrinsic Selectivity of Life
Another evolutionary question that the stable complex model can help explain is self-organisation origin. Self-organisation refers to order in a complex system that occurs by itself and within itself as opposed to be induced by external factors. Deng reasons that the stable complex evolution model explains the self-organisation properties of biomolecules display such as their natural tendencies to react with each other. The model emphasises two main aspects of the complementary interactions between molecules that are vital to induce evolution: one is metabolic system and the other is genetic system. Importantly, he notes that such genetic evolution could have added to the complexity of the metabolic system over time, making it the complicated system it is today.

Behind the Research
Mr Shaojie Deng
Details
Mr Shaojie Deng is a senior geological engineer at the Chongqing (Fengjie) Municipal Bureau of Planning and Natural Resources. Many years ago, he began conducting research on the origins and evolution of life, a subject for which he is very passionate. In 2020, he published a book in Chinese entitled, The origin and evolution of life, which discusses a wide range of biological phenomena.

References

Personal Response
In an ideal world, how would you see your work taken forward and applied?

The stable complex evolution model and the principles of adaptive evolution are a set of new concepts and methodologies. In a Chinese book published in 2020, I attempted to utilise these concepts to explain many biological phenomena. Currently, I am further demonstrating and expanding this theory. With the growing understanding of these new concepts, I hope that we can understand biology. Our understanding of life faces certain impasses, such as the origin of the genetic code and the theory of evolutionary mechanisms. Breaking through these impasses may require trying new approaches.

Research Objectives
Mr Shaojie Deng proposes the stable complex evolution model, which offers an explanation for the fundamental characteristics of life: the origins of the genetic and metabolic systems, whose evolution he proposes are intrinsically linked.

Bio
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