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A Scientific Reconsideration through Evolution and Structural Biology: What Came First: The Chicken or the Egg?

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Abstract

The classical question, "Which came first: the chicken or the egg?" has intrigued philosophers and scientists for centuries. While traditionally viewed as a paradox, modern evolutionary biology and molecular evidence provide frameworks for resolution. Reformulated, the broader question becomes: which came first—the multicellular organism or the reproductive cell (egg/ovule)? Evolutionary theory clearly indicates that cells preceded organisms, linking the concept of the egg to the origin of life itself. In contrast, structural biology provides a narrower answer to the chicken-specific case. Research at the Universities of Sheffield and Warwick (2010) demonstrated that the protein ovocleidin-17 (OC-17), essential for eggshell calcification, is only found in the chicken ovary, suggesting the chicken must have preceded the chicken egg. Here, we explore both perspectives, integrating evolutionary, philosophical, and structural-biology evidence, and propose that both answers are valid but context-dependent. Evolution places the cell/egg first in a general biological framework, while structural biology supports the chicken-first scenario in the specific case of bird reproduction.

Keywords: Structure-Function relationship, Proteins, Ovocleidin-17, Ovule, Egg, Calcium carbonate Chicken, Evolution.

Introduction

For centuries, the question "Which came first: the chicken or the egg?" has been posed as a paradox of causality and origins. Early philosophical treatments saw it as a circular riddle without resolution, while modern science has reframed the issue within the context of evolutionary biology and molecular mechanisms.

The classical form of the question is narrow, limited to a single species—the chicken. A more scientifically meaningful version asks: **Which came first, the multicellular organism or the reproductive cell (egg/ovule)?** This reformulation situates the debate within the broader framework of the origin of life and evolutionary transitions, from unicellular organisms to multicellular complexity.

This article examines both perspectives:

- **Evolutionary biology**, which shows that the cell (egg/ovule) preceded complex organisms.
- **Structural biology**, which, in the case of chicken reproduction, demonstrates that the chicken's physiology must precede the formation of its egg.

The Evolutionary Perspective: <u>The Egg (Cell) Came First</u>

Evolutionary theory provides a straightforward answer when the question is generalized beyond chickens: the egg, defined broadly as the reproductive cell, predates multicellular organisms. The first living systems were unicellular, and the transition to multicellularity occurred much later in evolutionary history, Figure 1.

Thus, when reformulated as **"Which came first: the multicellular organism or the cell/egg/ovule?"**, the answer is unequivocal—the cell came first. This reasoning applies universally to crocodiles, snakes, chickens, and indeed humans: all multicellular life forms originate from cells that existed before the organisms themselves.

In this sense, the chicken–egg paradox collapses under evolutionary reasoning, replaced by a hierarchy of emergence consistent with other natural laws, such as gravitation or radiation. Evolution, therefore, functions not as a philosophical puzzle but as a fundamental principle governing life's origins and diversification.

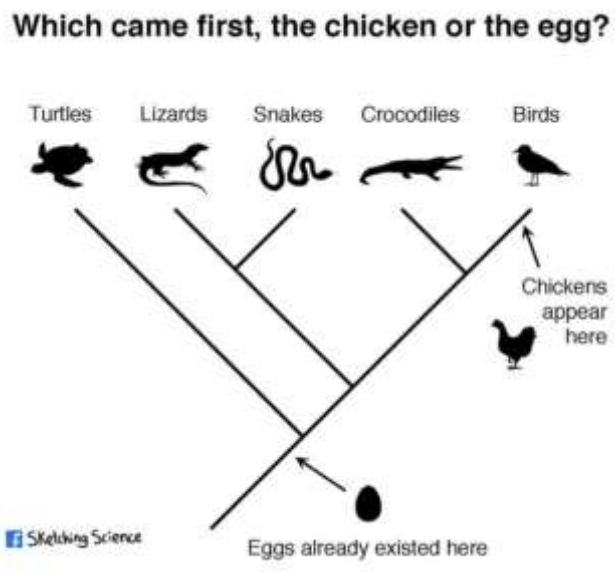

Figure 1. Evolution biology analysis suggests that Eggs evolved much earlier than Chicken.

The Structural Biology Perspective: The Chicken Came First

In 2010, a research team from the Universities of Sheffield and Warwick addressed the classical chicken–egg question by studying the molecular mechanism of eggshell formation. They identified a critical protein, **ovocleidin-17 (OC-17)**, that plays a key role in initiating calcite crystallization, the process that produces the eggshell.

Importantly, OC-17 is found only in the ovaries of chickens and related birds. This means that without the chicken's physiology, the eggshell cannot form. Therefore, in the restricted case of the chicken egg, the chicken must have come first.

Structural Studies of Ovocleidin-17

Several structural-biology studies have elucidated the fold and mechanism of OC-17. Crystal structures of the protein are available in the Protein Data Bank (PDB), including the entry **1GZ2**, which reveals its conformation and provides insights into its calcification role. Such data allow detailed investigations using computational tools such as the **SSFS (S**equence, **S**tructure and **F**unction **S**erver**)**, developed by the University of Saida, Algeria [5]. Refer to the structural details of the 1GZ2 in Figure 2.

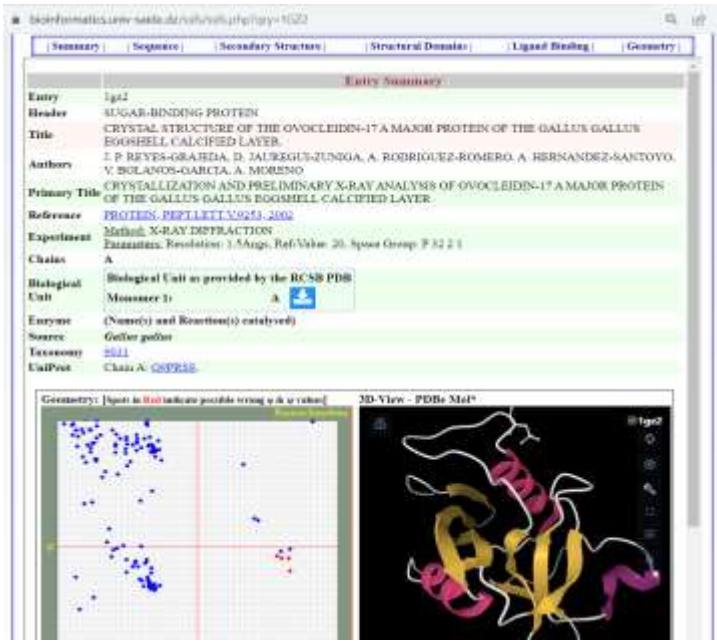

Figure 2. The Ovocledidin-17 protein structure as presented by the SSFS tool [4].

These structural insights highlight how evolutionary processes can manifest in highly specific molecular adaptations, underscoring the complementarity between evolutionary and structural perspectives, Figure 3.

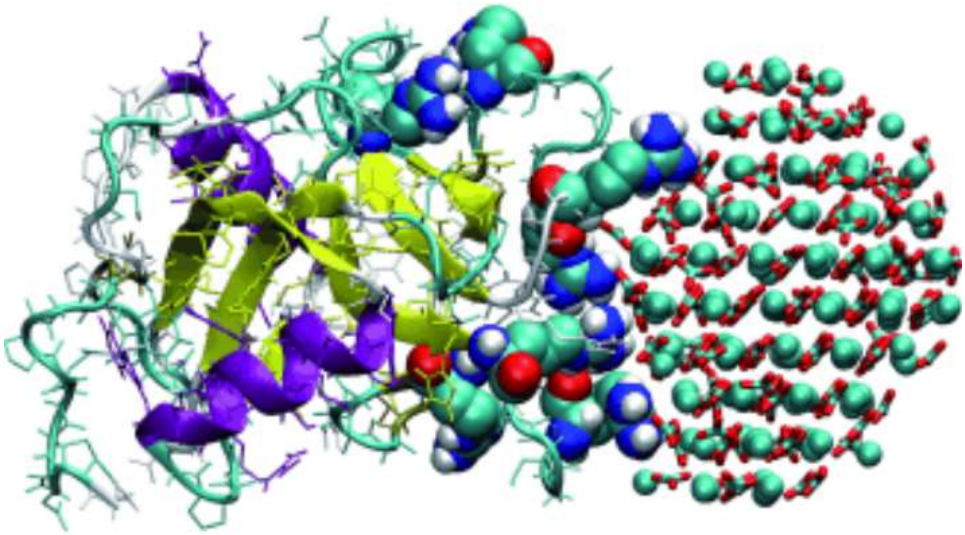

Figure 3. The calcifying protein Ovocledidin-17 as it crystalizes Calcium carbonate (Ca2Co3) for eggshell creation, (Artitistic impression) [1]

Reconciling the Two Perspectives

The apparent contradiction—evolution says the egg came first, while structural biology says the chicken came first—is resolved by recognizing the difference in scope:

- **General scope** (evolutionary biology): The egg, as a reproductive cell, predates all multicellular organisms.
- **Specific scope** (chicken reproduction): The chicken, with its unique physiology and OC-17 protein, must precede the chicken egg.

Thus, both answers are correct but context-dependent. Evolution provides the universal principle, while molecular biology provides the mechanistic detail for specific species.

Conclusion

The chicken–egg question, once a philosophical paradox, can now be answered scientifically from two complementary perspectives. Evolutionary biology demonstrates that the reproductive cell (egg) preceded multicellular organisms, making the egg "first" in the broadest sense. Structural biology, however, shows that in the case of chickens, the chicken's physiology is necessary for the egg's formation, making the chicken "first" in the specific context of avian reproduction.

Rather than a contradiction, these perspectives illustrate how scientific inquiry can resolve age-old questions by reframing them within appropriate contexts and levels of analysis.

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