Post-Evolutionary Theory: Probabilistic Geometry and Structural Genesis

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Abstract

This study proposes to conclude Darwinian "evolution theory" not as the final principle of biological diversity but as a historical descriptive model, and to provide a new foundation of natural history based on *probabilistic geometry* and *structural genesis*. While natural selection and adaptation remain useful, they cannot fully account for phenomena generated by DNA-constrained developmental processes, environmental interactions, and stochastic fluctuations. Insect diversity exemplifies this limitation: even within Hemiptera, we observe extreme divergences, from cicadas (Cicadidae) to treehoppers (Membracidae) with bizarre protrusions or camouflage species blending into bark. Such differentiation must be understood as emergent outcomes of DNA expression dynamics $\times$ environmental fields $\times$ probabilistic processes. We formulate state spaces, measures, and limits ($N \to \infty$), showing diversity as visibility of rare events through laws of large numbers, large deviations, and scaling principles.

1 Mathematical Framework

Let genetic space be $\mathcal{G} = \{A, C, G, T\}^L$, environment $E(x,t)$, developmental state $X \in \mathcal{X} \subset \mathbb{R}^d$, phenotype $p = \Phi(X)$. Stochastic developmental dynamics:

$$dX_t = -\nabla U_g(X_t; E_t)\, dt + \Sigma_g(E_t)\, dW_t, \quad X_0 \sim \mu_0(g).$$

Population measure:

$$\rho_t^{(N)} = \frac{1}{N}\sum_{i=1}^{N} \delta_{p_i}, \qquad N \to \infty : \rho_t^{(N)} \Rightarrow \rho_t.$$

Large deviation principle:

$$\mathbb{P}(\rho_t^{(N)} \approx \eta) \asymp \exp\{-N I_t(\eta)\},$$

where I_t is the rate function determining dominant diversity shapes.

2 Case Study: Cicadas and Treehoppers

Model for morphological pattern $y \in \mathbb{R}$:

$$dy = -\partial_y V_g(y; E)\, dt + \sqrt{\epsilon}\, dW_t, \quad V_g(y; E) = a_g(E)y^2 + b_g(E)y^4 + \cdots .$$

Sign change of $a_g(E)$ induces phase transition to camouflage. In the scaling limit $N \to \infty$, $\epsilon \log N \to c$, rare morphologies gain finite probability mass and stabilize.

3 Conclusion and Philosophical Supplement

Insect diversity naturally emerges from developmental geometry and probabilistic limits. Evolution remains respected as historical description, while diversity becomes a science of generative measures. Ultimately, whether this reflects divine plan or chance is transcended: from a post-postmodern philosophical stance, both are affirmed as relational existence. Diversity is the complementarity of order and fluctuation, and our existence is grounded in this relation.

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