Examining evolution from a cellular perspective

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The evolutionary processes of unicellular and multicellular organisms are continually under debate. John Torday, Ph.D., a lead investigator at Los Angeles Biomedical Research Institute (LA BioMed), has recently co-authored a book entitled Evolutionary Biology, Cell-Cell Communication and Complex Disease, which incorporates cell biology into evolutionary biology. Rather than focusing on multicellular organisms, the book concentrates on the cell as the smallest unit of biologic structure and function. This is the first time that evolution has been looked at from the cellular mechanistic perspective, making evolution more accessible and relevant to all of biology and medicine.

According to Dr. Torday, "Understanding evolutionary biology is key to integrating biology. To accomplish this, we need a mechanism for the process of Natural Selection that explains how novelty in vertebrate evolution is generated, how selection pressure has made wings from limbs, lungs from swim bladders, and integrated physiologic regulatory mechanisms like lipid metabolism and respiration, photoreception and circadian rhythms, water balance and erythropoiesis," said Dr. Torday. "Evolutionary-developmental biology provides an opportunity to exploit contemporary cell-molecular developmental biology, yet it has not been used effectively because we don't have an algorithm to convert genes into phenotypes. That leaves a huge gap in evolutionary biology that must be filled to provide plausible answers for how evolution has generated physiologic phenotypes. Since cells generate phenotypes from genes, this is a logical way to understanding evolution that's been 'trumped' by our zeal to reduce everything in biology to genes. Evolution,

like cell biology, is a process, not a thing."

Evolutionary Biology, Cell-Cell Communication and Complex Disease is focused on the scientific evidence that unicellular organisms are the origins of metazoans, and that metabolic cellular cooperativity is the central evolutionary mechanism being selected for. By examining the Gene Regulatory Networks (GRNs) that mediate these processes, the mechanisms underlying the evolution of a particular group of organisms (phylogeny) using the developmental history of an individual organism (ontogeny) can be leveraged, and visa versa, filling in the missing links using a mathematical algorithm like the Periodic Table.

The power of this novel approach is exemplified by focusing on GRNs that mediate cell-cell communication common to both ontogeny and phylogeny (independent of time), merging them into one common data set to determine the ultimate physiologic principles. The concept of cell-cell communication spans all of biology, from its initial conditions to preventive medicine. Evolutionary Biology will clarify this perspective, providing insights to experimental evolution.

In addition to being a lead investigator at LA BioMed, Dr. Torday is a Professor of Pediatrics and Obstetrics/Gynecology at the David Geffen School of Medicine at UCLA. He is a pioneer in the field of developmental lung biology, with current research interests in the developmental/phylogenetic origins of lung cell phenotypic heterogeneity and the gene regulatory network determinants of lung evolution. He is particularly interested in using evolutionary biology of the lung as an approach to clinical diagnosis and treatment of chronic lung disease, and as a prototype for predictive and preventive medicine.

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