Evolution of Cellular Complexity:

Philosophy, Cell biology and Symbiosis

In honour of Lynn Margulis (1938-2011)

Stubborn and iconoclastic, briliant and increasingly dogmatic, Lynn Margulis inspired a generation of biologists to think differently about the evolution of cells."
- John M. Archibald, CURRENT BIOLOGY, 2012

Lynn Margulis was a reputable and amazing, if controversial, biologist who effectively prevailed on the scientific community to accept the symbiotic theory of cell evolution. In 1967 she published – as Lynn Sagan – *On the origin of mitosing cells*, by far the most serious modern effort in defense of the endosymbiotic theory. In this paper, rejected by more than fifteen journals, Margulis presented the endosymbiotic theory for the origin of eukaryotic cells and their internal complexity, asserting that specific organelles such as mitochondria, plastids and basal bodies of flagella had been symbiotically acquired. Later, her theory would be proven correct in the case of mitochondria and plastids but not for flagella.

This seminar will address the evolution of cellular complexity both biologically and philosophically. The keynote speaker, the molecular biologist John M. Archibald (Dalhousie University), will focus on the evolution of plastids and the quite remarkable endosymbiont-to-organelle conversion. João Daniel Arrabaça, a biologist, and Associate Professor in the Department of Plant Biology, FCUL, will focus on the evolution of mithocondria and the emerging challenges. Finally, the philosopher, and a post-doc in the CFCUL, Gil C. Santos, will discuss to which extent endosymbiotic theory can be considered a textbook case of emergent evolution.

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Centre for Philosophy of Science of the University of Lisbon
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Department of Plant Biology
Faculty of Sciences of the University of Lisbon

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PROGRAMME

>>22nd November, 2012
15:00-18:00
Auditorium of the FFCUL
Building C1, Floor 3 <<

An International Seminar in honour of Lynn Margulis (1938-2011)

15:00 - 15:20
Welcome and introductory remarks
By Ricardo Santos (Centre for Philosophy of Sciences, Faculty of Science, University of Lisbon, Portugal) and Ricardo Melo (Department of Plant Biology, Faculty of Science, University of Lisbon, Portugal)

15:20 - 16:00
Evolving complex photosynthetic life: historical and modern perspectives
By John M. Archibald (Canadian Institute for Advanced Research, Program in Integrated Microbial Biodiversity, Department of Biochemistry & Molecular Biology, Dalhousie University, Halifax, Nova Scotia, Canada)

16:00 - 16:15
'Crisis' break

16:15 - 16:45
Mitochondria and the improbability of life
By João Daniel Arrabaça (Center for Biodiversity, Functional and Integrative Genomics, Department of Plant Biology, Faculty of Science, University of Lisbon, Portugal)

16:45 - 17:15
Symbiosis as a case of Emergent Evolution
By Gil C. Santos (Centre for Philosophy of Sciences, Faculty of Science, University of Lisbon, Portugal) and *Ricardo Santos (Centre for Philosophy of Sciences, Faculty of Science, University of Lisbon, Portugal)*

17:15 - 17:45
Final debate
Moderated by Ricardo Melo (Department of Plant Biology, Faculty of Science, University of Lisbon, Portugal)

Evolving complex photosynthetic life: historical and modern perspectives | John M. Archibald

The evolution of photosynthesis in eukaryotic (nucleus-bearing) cells was a landmark in the history of life. Plastids – the light-harnessing sub-cellular organelles of plants and algae – evolved from once free-living cyanobacteria by endosymbiosis approximately one billion years ago. In this lecture I will provide an overview of the 'who, what, when and how' of organelle evolution in eukaryotes, with focus on recent genomics-enabled advances in our understanding of plastid evolution. Examples of 'recently' evolved photosynthetic organelles will also be discussed as they pertain to the fundamental question of how an endosymbiont becomes an organelle.

Mitochondria and the improbability of life | João Daniel Arrabaça

Mitochondria are known as the powerhouse of cells and exist in all eukaryotic organisms. Although significant differences exist between mitochondria from animal and plant tissues, the basic functioning of energy transduction mechanisms is very similar, indicating the probability of evolution from a common ancestor, about 2.10^3 million years ago. Our understanding of these mechanisms was based on the notion of chemiosmosis, perhaps the first biological "scientific" theory, on Popper terms. Examples of differences and similarities among these organelles, and their multifarious functions, shall be briefly discussed.

Symbiosis as a case of Emergent Evolution | Gil C. Santos and Ricardo Santos

As a philosophical theory about the structure and developmental processes of natural reality, and also about our knowledge about it, emergence theory has nowadays two major problems: to give a positive characterization of emergence, avoiding some of the usual negative and ambiguous notions such as non-reducibility, or non-predictability, and to give concrete examples in natural sciences of instances of emergence. We will address these two major problems, showing how symbiosis can be regarded as a concrete instance of ontological emergence as defined by us.