Sunday, June 27 AM 9:00-12:00, Room 100

Session 2 (room 100): **20th Century Science II**

Anya Plutynski, "The Fate of Evolution as an Historical Science"
Leo Napinen, "Philosophical Interpretation of Ilya Prigogine's Theories"
Peeter Muursepp, "The Arrow of Time: From Boltzmann to Prigogine"

"The Fate of Evolution as an Historical Science"
Anya Plutynski

Evolutionary biology is relatively unusual among the natural sciences in that its subject matter is historical; evolutionary biologists study the history of life. Why and how does the historical character of evolutionary biology affect its nature as a science? In this paper, I examine three historically influential biologists' answers to this question: Ernst Mayr, Richard Lewontin and Stephen Jay Gould. All three resist reductionistic treatment of biological questions. Mayr claims that if we are to understand the ecological and geographical conditions of speciation correctly, natural history must not be supplanted by lab biology. Gould argues that long-term historical patterns and processes are not mere by-products of lower level patterns are processes, and so require explanations pitched at levels above the gene or the population. And, Lewontin argues that the complexity of genotype-phenotype relationships prohibits easy answers to evolutionary questions via examination of patterns of genetic variation.

The protests of these biologists notwithstanding, modern evolutionary biology has taken a molecular turn. Paleontologists, systematists, and developmental biologists use molecular methods to investigate evolutionary questions. These disciplines, whose prior focus was whole organisms, now trade in gene sequences. Indeed, it is extremely difficult to get funding for the sort of natural history that Mayr claims is essential to understanding the patterns and processes of diversification. Have the presuppositions of the arguments of these influential biologists become dated? If so, how?

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"Philosophical Interpretation of Ilya Prigogine's Theories"
Leo Napinen

No abstract available

"The Arrow of Time: From Boltzmann to Prigogine"
Peeter Muursepp

Ludwig Boltzmann was the first to deal seriously with the problem of inclusion of the arrow of time into physics. Initially, he thought that he had successfully proved the determination of the arrow of time by the evolution of the dynamical systems from less probable conditions to more probable ones. The objections of Zermelo and Poincar', however, made him change his position. As the result, Boltzmann gave up the idea of the objectivity of the arrow of time reducing it to the level of our subjective conceptions, which we as human beings impose on the reality. According to Ilya Prigogine, the failure of Boltzmann was caused not just by inadequate response to criticism but an incorrect interpretation of the second law of thermodynamics. Boltzmann had considered the second law a practical principle expressing only practical improbability of one or another process.

Karl Popper took the next important step in the history of the arrow of time. *Sir* Karl considered the flow of time in the sense of a temporal view of the universe as a physical basis of the arrow of time. Popper built his arguments on irreversible processes. Michael Esfeld has observed that irreversible processes do not provide an argument for assuming an arrow of time in the cosmological sense. Esfeld holds that a Newtonian world can include an arrow of time without having to contain irreversible processes. It is quite surprising, however, that Esfeld has neglected both Boltzmann and Prigogine in his analysis of Popper's considerations of the arrow of time. Probably by this reason, his treatment of the arrow of time rests on a quite narrow basis.

Prigogine has commented extensively on the main ideas of Boltzmann and Popper concerning the arrow of time. However, Prigogine does not limit himself with comments. It is just Prigogine who has provided an exhaustive analysis of the concept of the arrow of time in several contexts: theory of heat, entropy, biological and historical evolution, cosmology (expansion of the universe). Prigogine is convinced of the objective character of the arrow of time. In principle, the arrow of time is firmly put in place by the Big Bang itself. Probability cannot be the basis for the arrow of time as the probabilistic approach presupposes the unique direction of time already. Prigogine postulates the second law of thermodynamics as a fundamental theoretical fact, as a principle of selection leading to the breaking of time symmetry. He treats the breaking of time symmetry as an inner quality, meaning that the breaking of time symmetry is not forced by new interactions. Only the treatment of time as an operator by Prigogine can make it possible to explain the inner breaking of time symmetry simultaneously in mechanics, quantum physics and relativity theories.