Why does theoretical biology not exist? Life in the Universe as an anomaly, a puzzle, and a counterinstance

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Theoretical biology is a science addressing the most basic questions of biology, such as “What it is to be alive?”, from as general a point of view as possible. It is not, however, in any fruitful dialogue with “mainstream” biology; rather there is a deep conflict between the two, and the latter scarcely recognizes the questions of the former as worth of systematic enquiry. During my residency at Susimetsa, I analysed this situation by a historical-philosophical approach, in which I distinguish three phases in the history of biology. Inspired by Thomas Kuhn, I call the phases “Life as an anomaly”, “Life as a puzzle”, and “Life as a counterinstance”.

The first phase begins from Newton, and ends around World War II. It is characterized by two originally distinct processes, which would eventually fuse together: firstly, the development of physical *principles*, which via chemistry and biochemistry came to reach even the biological realm; secondly, the delineation of the initially intangible life as a unified *phenomenon*, localizable both in space (the Earth) and time (evolutionary history), and sharing a common material basis (the cell).
These two processes culminated and confronted each other particularly strikingly between the two World Wars, which is when life was really perceived as an anomaly in the “physical world”.

The second phase begins from the re-interpretation of the Mendelian gene as a fragment of the DNA molecule, in the mid-20th century, and ends with problems raised by systems biology at the end of the same century. Characteristic of this phase is the presupposition that life had in essence been
“explained”, as a puzzle: the gene was seen as something distinctively biological while being “fundamentally” a molecular structure; correspondingly, natural selection was seen as a generator of distinctively biological histories while acting “fundamentally” on physical processes. Commitments to these beliefs became ingrained into textbooks of biology; thus, they were, and are still, rarely questioned. In a sense, it became a part of the paradigm to just presume their validity, without further arguments. This is why theoretical biology does not properly (co)exist.

The last phase, which is what biology is currently living through, is about the realization that the original commitments were, after all, too simple and too naïve. DNA can only function as a gene within a living cell, and of *that* there is no “molecular interpretation” available; likewise, evolution by natural selection only takes place if there *are* organisms capable of both responding to and generating selective pressures, and it is no longer so evident what to think of that. It appears that now, biology cannot adopt fundamentals from elsewhere and “merely explain”;

rather it needs to develop its own new principles. But what the history of science suggests is that the replacement of old principles by new is usually a twofold process: there is the discovery of the new principles themselves, *and* an explicit realization of what was wrong with the old – i.e. the old "general" becomes "special" in the new situation. In the present case, this implies that the traditionally presumed general-special relation between physics and biology is, in a way, turning upside down.

The implications of this for science are deep and surprising. However, the fact is that life exists in the Universe, and if it appears as anomalous from the point of view of the fundamentals, then of course it is the fundamentals, not the phenomenon, that must adapt. If so, then the basic questions of theoretical biology can hardly be bypassed any longer, but should, instead, be recognized as perhaps the principal issues in that field of inquiry which used to be known as *philosophia naturalis*.