The Biophysics of ‘Organisms’ Not Existing in Nature

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When I was asked to write this preface, the first thing I remembered was Prof. Dr. Shin’ichi Ishiwata’s preface to the 50th-anniversary issue for The Biophysical Society of Japan (the magazine, “Biophysics (SEIBUTSUBUTSURI)”, Vol.50 No.1, 2010). In light of this, I would like to consider the future of biophysics.

Prof. Ishiwata suggests that the future goal of life science is to study the functions of organisms that do not exist in nature, and that the life science should develop into a discipline that asks the essential question of “what the life is”, regardless of whether it is natural or unnatural. Many people think that creating ‘organisms’ not existing in nature is engineering, not science. But in biophysics, such study is also the science of getting to the heart of the matter. At the time, I had a vague image of this, but his preface made me feel that the fog had been lifted.

Although non-living materials have specific physical properties and do not acquire new functions over time, life (living materials, organisms) can acquire functions and change its physical properties through evolution and adaptation. Therefore, the life we see now is not the whole of life. For example, if biophysicists were on a primitive Earth, they would not understand the aerobic organisms that would emerge later just because they understood anaerobic organisms so well.

What, then, can a biophysicist at that time do when he or she seeks a deeper, more general understanding of the nature of life? It is to create and analyze that which does not exist in nature but has potential (i.e., analysis based on extension). That is, “The biophysics of ‘organisms’ not existing in nature”. It's as big as humans can imagine, so it's not as big as it could be, but it still expands the realm a bit. The methodology of the analysis based on the extension was the same in the condensed matter physics field, where I studied as an undergraduate.

The biophysics of ‘organisms’ not existing in nature is a science that looks into organisms' future. Just as aerobic organisms that can live efficiently using the oxygen discharged by cyanobacteria were born, new organisms that can live efficiently using semiconductor devices discarded by humans may be born. So, research on biomolecular sensors integrated with semiconductor devices may be not only the engineering but also the science of future organisms. Biophysical research is completely borderless. Suppose the biophysics of ‘organisms’ not existing in nature will discover “new phenomena of life” and lead to a fundamental understanding of “what life is”. In that case, such a fact will be fascinating. Prof. Ishiwata mentioned that biophysics has two sides: fundamental physics that questions our origins, and applied physics that points out our futures. It would be interesting to see one of the possible organisms of the future, even in the present, even if it's only a bit.