SL09 **Pharmaceutical Sciences in Life Science — Expectations for pharmaceutical Sciences—**

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Life sciences have made remarkable advances. In particular, for the past three decades, dramatic, wide-ranging changes have occurred. The changes include new developments in fields such as: gene-altering technology and genome editing; analysis of protein spatial structure and drug design; human genome sequencing and tailor-made medicine; vivo and molecular visualization and bio-imaging technology; regenerative medicine and gene therapy. For example, concerning genome sequencing, the speed of sequencing now is 100,000 times as fast as the speed in the early years of this technology. The development of life sciences has involved not only traditional life science fields such as pharmaceutical sciences, medicine, agricultural science and biology but also a variety of other fields, including engineering, information science and chemistry. It is AI (artificial intelligence) that is having a particularly great impact. AI is about to drastically change not only life sciences but also society itself. This trend is affecting pharmaceutical sciences significantly. In the field of pharmaceutical sciences, expectations are high not only for research on nucleic acids and proteins but also for the analysis of carbohydrates and lipids.

My research has focused on developmental biology. In this field, there have been remarkable advances in molecular genetics, mainly with respect to genes and genomes. In this field, drosophila, frogs and mice are used as model organisms to examine the mechanisms of morphogenesis and organogenesis. The mechanism of differentiation as part of the organogenesis process is now closely related to regenerative science and medicine. Mostly the same genes are used in the organogenesis processes of both frogs and mice, indicating that their organogenesis processes are based on identical systems. Factors of muscle formation such as MyoD, myf5, Myogenin, and MRF4 use the same genes, and this fact has shed light on the relationship between gene expression and diseases. Activin, which was discovered as a differentiation-inducing factor, has been found to be related not only to organogenesis but also to memory and human collagen disease.

When it comes to regenerative science, only using drosophila and mice as model organisms has its limits. There are other organisms–such as planaria and newt—that have a high level of regenerative capability. If we use other organisms as models, we can find something new about regeneration. For example, newts whose limbs have been severed can regenerate new, fully functional ones. The presence of stem cells and the mechanism of dedifferentiation enables such regeneration. Currently, it is said that there are around 8 million species of living organisms. Only around 300 species, or less than 0.1%, are used as model organisms. We have much more to learn from biodiversity. As the human history is only around 200,000 years long, humans are a relatively new species on the earth. If we are to understand humans as an organism, it is very important to understand other species of organisms. By looking at other species, we can discover new phenomena and new matters, and new molecules. This is also true in the field of pharmaceutical sciences.

I expect that the day will soon come when researchers in the field of pharmaceutical sciences use AI. This is expected to bring significant changes to such activities as research on life phenomena, examination of pathological conditions, development of drugs and maintenance of health span. The relationship of pharmaceutical sciences to society will also change significantly. Therefore, I would like to explain the expectations that I have now for pharmaceutical sciences.