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Interview with Seung Yon Rhee

Seung Y. Rhee

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Seung Yon (Sue) Rhee was born in Seoul, Korea into a working-class family. Her family immigrated to the United States when she was 13 years of age and settled in the suburbs of New York City. Her early passions were various forms of visual arts ranging from the comics to films. She attended a small liberal arts college outside of Philadelphia called Swarthmore (BA in Biology, 1992) followed by graduate training at Stanford (PhD in Biology, 1998). She performed her thesis work at the Carnegie Institution for Science. After a short stint as a database curator in Stanford's Genetics Department, she returned to Carnegie as a Staff Associate in 1999 to start a new database project called The Arabidopsis Information Resource (TAIR). Since 2005, she has been a Staff Scientist at Carnegie. Her group is applying systems and integrative approaches to understand how plants adapt and acclimate to changes in their environment. Her group is currently developing novel approaches to identify new classes of transcriptional regulators, patterns of metabolic network evolution, and the genetic networks that control natural variation in salinity tolerance in plants.

What influenced your path into plant biology?

It's more about the who, rather than what, that have influenced my path into plant biology. The plant biology professors and scientists were the most captivating, energetic, and personable people throughout college and graduate school and I wanted to become a part of that community. I am glad and grateful that I am still a part of this community.

How did you decide on your current research topics?

I am interested in understanding how plants perceive signals from their environments and reprogram their growth and development. When I started my independent position 15 years ago, I wanted to pursue this question differently from the common approach utilized at the time (applying forward genetics and looking for important single regulators in a specific biological process). Because genes and processes do not act alone but rather in the context of genetic and epigenetic landscape [1], I wanted to rapidly identify all the genes involved in various processes and understand how the processes interact to reprogram growth and development upon environmental stimuli at the organismal level. I realized that I could not build a laboratory big enough that would allow pursuing this problem fast enough using conventional approaches. So I focused on first building an infrastructure around the model plant *Arabidopsis thaliana*, to combine all available information from the literature and large-scale data generation projects in one place, encode the data to be computable by algorithms and easily accessible by researchers, and thereby recruit a large body of the research community, all engaged in revealing the functions of individual genes and processes in this model plant. Towards this goal, we created The Arabidopsis Information Resource (TAIR; http://www.arabidopsis.org/), a comprehensive Web-based information resource for *Arabidopsis*. After having created TAIR and managed it for 10 years, I turned my focus from building the infrastructure to using it to reconstruct biological networks, identify functional modules and pathways from the networks, study their dynamics, and discover patterns in their function, evolution, and regulation.

What paper influenced you most?

It is difficult to single out the most influential paper. There are several favorites for different reasons. For its vision for the role of basic science in society, I pick Vannevar Bush's 'Science, the Endless Frontier', a manifesto addressed to President Roosevelt in 1945 on the importance of basic science and investment in scientific talent for the public welfare and security of a nation. For articulating the purpose of systems biology, I enjoyed Yuri Lazebnik's 'Can a biologist fix a radio?' [2], where he argues the need for developing and applying formal approaches to describe, model, and predict biological systems and processes. Barbara McClintock's Nobel prize lecture 'The significance of responses of the genome to challenge' [3] and G. Ledyard Stebbins' perspective 'A brief summary of my ideas on evolution' [4] are inspiring in thinking about the differences of plants and animals and how these differences may have shaped the evolution and function of plants. C. Stacy French's 'Photosynthesis' (in [5]) and Daniel Arnon's 'Sunlight, Earth life: The grand design of photosynthesis' [6] are historical perspectives on the discovery of photosynthesis that illustrate the excitement of the process of scientific discovery. Sewall Wright's 'The roles of mutation, inbreeding, crossbreeding and selection in evolution' [7] is a great example of a theoretical paper where he synthesizes the idea of balancing forces such as mutation, selection, population size, and breeding mechanisms to influence the direction and pattern of species evolution. Finally, Herman Spoehr's 'Form, forces, and function in plants' (in Cooperation in

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Research, Carnegie Institution, 1938, reprinted in [8]) is an inspiring piece that articulates the importance of studying the diversity of plant form evolution in light of their environments and biochemical functions. Some of the areas he mentioned have emerged as new fields such as ecological physiology and evo-devo. These papers have influenced the approach in my research, particularly the desire to combine methods and concepts from different disciplines in formulating and addressing scientific problems.

In hindsight, what in your research career has given you the most pleasure?

Positive and synergistic interactions with other scientists, particularly with the students and postdoctorates in my laboratory, have been the most fun aspects of my research career. Recruiting and advising people have been the most challenging yet rewarding part of being a group leader. I find that the most creative and unexpected ideas come from talking with other people, especially those with different backgrounds, levels of training, and areas of expertise. Scientific research is often a solitary journey whether it is conducting experiments or interpreting the results. The depth of intellectual exploration is often filled with self-doubt and skepticism. Communicating my ideas and results with others has often led to insights that would not have come up by simply reading or thinking hard about the problems in solitude. I find that the most creative solutions have come from talking with people and that synergism is what makes being a scientist fun.

What big questions interest you in the long term?

I hope to combine different approaches and concepts in various fields such as plant physiology, evolution, genetics, computer science, engineering, and statistics to better understand the evolutionary and molecular mechanisms of adaptation in plants. I am interested in understanding what the various traits and forces are that need to be balanced to adapt to fluctuating environments. I would also like to understand how plants perceive and integrate all the environmental signals to change the physiology and development at molecular, cellular, and organismal levels. In particular, I am interested in understanding how genomes are structured in three dimensions and modified in response to stress in plants and how the structural modifications and spatial organization of the genomes in the nucleus can affect gene expression and evolution of pathways and networks.

What is the best advice you have been given and what advice would you give?

The importance of communication in science is something I wish I had learned earlier in my career. For too long, I thought that the most important thing in science was to work on interesting and important problems, plan and conduct experiments well, and produce good results. Later I realized that these are necessary but not sufficient to be successful in science. It is important to communicate one's science to others effectively in light of the recipient's perspective. When writing a manuscript, it is important to first consider the reader, when giving a talk, to first consider the audience, when writing a proposal, to consider the peer reviewer, and when talking to a non-scientist, to consider what the person values.

References

1 Waddington, C. (1957) *The Strategy of the Genes: A Discussion of Some Aspects of Theoretical Biology*, George Allen & Unwin
2 Lazebnik, Y. (2002) Can a biologist fix a radio? – Or, what I learned while studying apoptosis. *Cancer Cell* 2, 179–182
3 McClintock, B. (1984) The significance of responses of the genome to challenge. *Science* 226, 792–801
4 Stebbins, G.L. (1999) A brief summary of my ideas on evolution. *Am. J. Bot.* 86, 1207–1208
5 Johnson, W.H. and Steere, W.C., eds (1962) *This is Life: Essays in Modern Biology*, Holt, Rinehart, and Winston
6 Arnon, D.I. (1982) Sunlight, Earth Life: the grand design of photosynthesis. *Science* 22, 22
7 Jones, D.F. (ed.) (1932) *Proceedings of the Sixth International Congress of Genetics*, Genetics Society of America
8 Haskins, C. (ed.) (1967) *Search for Understanding*, Carnegie Institution of Washington

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Interview with Alisdair R. Fernie

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Alisdair Fernie was born outside of Cambridge, UK, but grew up in a small town to the west of London. He studied biochemistry and molecular biology as an undergraduate at the University of Sheffield (BSc 1995) and went on to complete a PhD at the Department of Plant Sciences at the University of Oxford (1998). Following working as a postdoc in the laboratory of Lothar Willmitzer at the Max Planck Institute of Molecular Plant Physiology, Potsdam-Golm, Alisdair started his own research group in the Institute. Since 2003, he has been running the Central Metabolism group at the Institute, where he is a tenured research scientist. Although his research interests span genetics, metabolism, and physiology, they

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