Is light the absence of darkness?

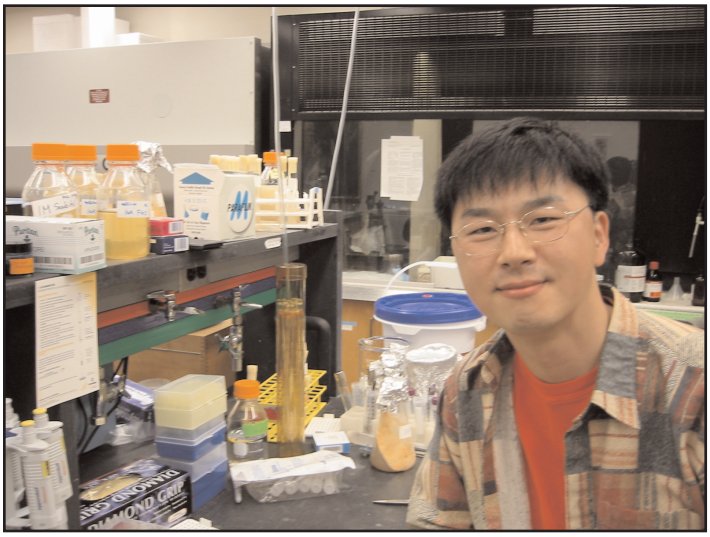
An Interview with Dr. Kwangwon Lee, Assistant Professor of Plant Pathology

by Derek A. Cabrera[1]

The process of science is the process of understanding patterns, especially in places where no pattern is immediately obvious. So it was something of a science when I sat with Dr. Kwangwon Lee, who joined the Cornell Life-Sciences-Genomics Initiative in 2003 as an assistant professor of plant pathology, to find out more about his research. At first, Dr. Lee's diverse background seems to escape pattern. He completed his undergraduate degree in genetic engineering in his native country of South Korea. At Chicago State University he earned a Masters degree in biological science, and a PhD in plant pathology and microbiology at Texas A&M led to five years of postdoctoral training at Dartmouth Medical School. And, of course, there was that one-year stint in seminary at Calvin College. Huh? Combined with the philosopher's musing written on Dr. Lee's blackboard, "Is light the absence of darkness?" I was stumped in finding a pattern that integrated Dr. Lee's diverse training and experience.

In 2003, Dr. Lee joined the Life-Science-Genomics Initiative faculty as a plant pathologist. "When I came for an interview, I really had a good time and really instinctively said, 'This is it, this is the place that I want to work.' The hiring process is very unique and ideal; it is superior to other systems. Interdepartmental faculty get together and ask themselves, 'What is the strength of our group and what is the weakness of our group?' And then they say, okay, these areas need to be strengthened. Strategy first, then make the job offer, hire people and then delegate them to the department. I had to meet more people, but that makes this position more attractive because I know that when I come to the department, I will have resources outside the department. When I met Steve Tanksley and other people hired by the Initiative, there is a spirit that they want me to be successful, then we are all successful. That's very attractive and I wanted to be a part of it. I didn't experience this at other places I applied. The Cornell Life Science-Genomics Initiative is very unique."

"I have a diverse background, but there's a pattern, there's a common denominator," Dr. Lee assured me. That pattern, as it turns out, is what makes Dr. Lee and his research so unique. "I studied fungi in a eukaryotic model system called Neurospora crassa. Actually, this was the organism that opened up an era of molecular biology in 1941. I looked at the physiology of fungi, then the molecular biology, basic biology and then in medical school I was dissecting this organism to study its molecular structural clock—the circadian clock. So then, as I am thinking about



my own research program, I naturally think about what I am going to do and I looked at my training and because I was trained in so many different fields, I see an opportunity. I can combine them. So I asked, 'what is the role of the circadian clock in the agricultural context?'"

Dr. Lee studies the circadian clocks of fungal pathogens to determine if controlling these clocks could have an effect on the creation of "progeny spores" – the fungi's offspring and the first step in the development of disease. "We know that this asexual or sexual development is making tons of spores of this fungal pathogen and that this process is regulated by light. I mean, we know it. There is a lot of documentation. But no one has carefully studied it at the molecular level and tried to control it." By metaphor, Dr. Lee is using light as a birth control method for plant pathogens. But Dr. Lee's research doesn't merely promise to control plant pathogens; there are currently toxic chemicals and expensive procedures to do just that. What Dr. Lee envisions is that we could control these pathogens by using an inexpensive, environmentally sound light source at critical time periods. "I'm working on Magnaporthe grisea, which is a pathogen for the rice plant, and these spores release to the air only in the nighttime. From the perspective of epidemiology, that's the step that I want to use light conditions to control disease. The same principle can apply to fungal pathogens in greenhouses, if you can suppress the spread of spores by light condition. I have the data showing that the regulation is so strict that when you turn the light off, most spores release. And, that is not just a random event. There's a specific wavelength of light that controls this phenomenon. So, here I'm proposing light condition as a control method, a disease control method, instead of chemicals."

Controlling pathogens by manipulating the pathogen-plant environment is not a new idea. "There is a great deal of study on controlling temperature and humidity in the field," say Dr. Lee, "but when you think about it, it is very difficult to control temperature and humidity in the field. But light condition, we can control, and light is a more economic way of controlling disease. So there is an opportunity because there is a lack of systematic study of the role of light in terms of pathogenic microbe-host plant interactions and I think that there is a niche that I can contribute to."

"Dr. Lee has expertise in the roles of the circadian clock and ambient environment in fungal biology and will apply his knowledge to genomic analysis of plant-microbe interactions. Though these interactions are driven by environmental factors, there has not been a comprehensive analysis of the role the environment plays in regulation of genes involved in disease development or host response. Kwangwon's research will analyze how microbes optimize pathogenicity strategies, based on environmental cues. Society will benefit from this work because of its positive impact on food safety and the environment."

—Dr. Rosemary Loria, Professor and Department Chair, Department of Plant Pathology

As patterns go, contribution to society is as important to Dr. Lee's research as the research itself. What are the "big questions" biology will face in the next ten years? Dr. Lee thinks they will all boil down to one big question, "So what?"

"I think the question to focus on now is, 'so what?' What I mean is—how does your lab research benefit society? I mean, the economy is on the decline, there are tight budgets and we use valuable tax dollars, so you have to ask, 'what can you give back to this society?' Even the researchers in the private sector or basic biology now feel pressured by this question of, 'so what?' Doing basic biology is very important, but we cannot dwell merely on just basic biology. We have to ask, 'What are the implications of this research? Are we asking the right questions, or just wasting time and money? How are you going to benefit society?' Not just in terms of productivity, but is it socially sound, for example, the organic farming and plant pathology? The question is, is it sustainable? It's not just a production problem - our problem is overproduction - but is it sustainable, is it environmentally friendly?' So it's more of a qualitative issue."

Dr. Lee's unique combination of scientific training and life experiences is what makes his cutting edge science such an innovative and useful contribution to society, to science, and to the Cornell community. He subjects his scientific research to an Occum-like razor—so what? What can it do for society?

In an hour interview, it becomes clear just how important the larger social, even spiritual, context is to Dr. Lee. The pattern can be traced back to his sojourn to Calvin College and seminary in the midst of his scientific training. "I believe in God, and I was not sure whether working in a lab day and night was really meaningful. I had this question that I could not answer, and I was so frustrated and isolated, not interacting with people and just working in the lab. You'd do an experiment ten times and only one time did it succeed. And, you ask yourself, 'what is the meaning of it?' I thought, 'I want a meaningful life, helping people and satisfying my spiritual life. At the time, I was an honors student all the way. I mean people think you are doing good, but the inner struggle says, 'I want to serve people, I want to serve God.' But I never lost my passion for science. I was just frustrated. I wanted to find a more meaningful life. Because of those experiences asking those questions, I think that I can contribute meaningfully to people's lives – even though I'm doing basic biology."

I asked Dr. Lee how he would advise aspiring scientists. "I would encourage them to explore – explore whatever they want. For example, if I was feeling that frustration now, it would be very difficult because I have a family and I have responsibilities. If I was stuck with that question— whether what I'm doing is really meaningful — I don't know what I would do. So, I would tell them to explore. After all my training in science, to then go back to seminary and then coming back to science, one might say that's a huge change, but I would say, I'm happy that it was done before, before I was really getting into the field and into this job that I'll do the rest of my life. So, I would say explore to find what is your real desire, is this something that you really want to do. Just explore that, don't hesitate to try."

The patterns of Dr. Lee's life and his work started to become powerfully clear. He is a man who loves the work he is doing, loves the place at which he is doing it, and sees a clear path between his lab and the social problems of the world. He is, in a word, passionate about his work and its meaning. What is he most passionate about each day? "Wow, this is a very personal question…Well, I have a prayer time in the morning when I read the Bible and I pray. That's what it's about."

And is all of your work an extension of this spiritual path? "Yes, yes it is." □

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