

Katherine Xue, Part Two

(As published in The Oak Ridger's Historically Speaking column the week of September 27, 2021)

Benita Albert concludes the two-part series on Katherine Xue. Her career has prepared her to be a strong influence for sound information about the Coronavirus, a rare thing in this world today of misinformation and changing instructions on how to best deal with the pandemic. Katherine is someone we Oak Ridgers can take pride in her accomplishments. Enjoy the rest of the story from Benita:

Oak Ridge High School (ORHS) 2009 graduate, Katherine Xue, is a postdoctoral fellow in biology at Stanford University. For the ten years between ORHS and her Stanford appointment in 2019, Katherine has amassed an amazing resume' of studies and experiences. Her passions for science and writing have commingled to make her a relatable and respected voice for scientific thought. She has published an article on immune memory against COVID-19 in *The New Yorker* magazine where she is an occasional contributor on COVID-19 issues. (Here is the link to the article:

<https://www.newyorker.com/science/annals-of-medicine/coexisting-with-the-coronavirus>)

Stepping back to the fall of 2009, Katherine entered Harvard University's undergraduate program where she would ultimately complete a degree in in Chemical and Physical Biology. Her freshman year found her reunited with a student, Seungsoo Kim, formerly known to her as an academic rival in National Science Bowl and USA Biology Olympiad competitions.

Seungsoo and Katherine soon bonded over being two of only a few freshmen in advanced biology and chemistry classes. She wrote, "We spent a lot of time together working on problem sets and ballroom dancing together—and the rest is history! We still love biology and love each other. (They married in 2018 during their doctoral studies in the Genome Sciences at the University of Washington.)

We spent our honeymoon in the Galapagos Islands, which was the trip of a lifetime for the both of us, and we both know very well that 'my experiment will be done in thirty minutes' means at least an hour and a half." This latter comment speaks to their current reality as they both conduct postdoctoral research programs at Stanford.

The activities Katherine pursued at Harvard include: research, literary magazine, ballroom dance, and undergraduate columnist for Harvard's alumni magazine. She chose to continue writing for one year after completing her undergraduate degree, serving as an associate editor for *Harvard Magazine*.

She said, "I covered academic developments and other university news, which was incredible fun—journalism is a dream job for anyone who loves to learn." Uncannily, one of her articles for the May-June 2014 edition was titled, "Superbug: An Epidemic Begins." It was a cover article on antibiotic resistance.

Summers during her Harvard years involved research opportunities, travel, and teaching. Katherine said, "The summer after my freshman year of college, I worked in Jeremy Gunawardena's lab at Harvard modeling metabolic pathways. The summer after my junior year of college, I worked in Kirsten Bomblies's lab, where I did my senior thesis research. I was studying how plants adapt to tetraploidy, which is the condition of having four copies of each chromosome rather than the two copies of each chromosome that humans have. Tetraploidy and genome duplication are very common in the plant world, but they require some adjustments to basic cellular machinery."

The summer after her sophomore year at Harvard, Katherine was a part of the World Teach program in Omaruru, Namibia. She taught math and physical sciences to eighth- and ninth-grade students.

In 2014, Katherine began studies in Genome Sciences at the University of Washington (UW), completing her PhD in 2019. Her research involved studies of the evolution of the influenza virus. She wrote, "In my PhD work, I studied how influenza viruses evolve at very small scales of space and time—in particular, during individual patient infections. Influenza viruses evolve incredibly quickly to escape human immune defenses, and this evolution is what makes it necessary to update the flu vaccine every year. New flu variants start with mutations that take place as the virus replicates during individual patient infections, and I wanted to observe and understand these earliest stages of viral evolution."

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"In my graduate work, I used cutting-edge genome sequencing methods to try to understand how and why flu viruses change inside your body while you're sick. I led one study of flu's evolution in immunocompromised patients, who sometimes have extremely long flu infections that can last weeks, or even months. In these patients, we found that flu viruses evolved extremely rapidly, and the viruses acquired some of the same mutations that arose on a global evolutionary scale as flu viruses circulated around the world. The results suggested that these unusually long patient infections could sometimes act as a microcosm for flu's global evolution. This study from my graduate work has become especially relevant in the past few months as new SARS-CoV-2 variants have emerged. The precise origin of these variants is still unknown, but many scientists suspect that the B.1.1.7 (Alpha) lineage, which was first observed in the UK, may have evolved in an immunocompromised patient. Several other studies have shown that SARS-CoV-2, the virus that causes COVID-19, often evolves rapidly in long-term infections, much like what we observed for influenza."

In a Seattle Town Hall, April 13, 2017, Katherine presented an overview of her graduate research. Her talk, "How the Flu Evolves in You," is a revealing personal discourse on the search process to a problem definition and the curious mindset so necessary in scientific inquiry. You may view her talk at: www.youtube.com/watch?v=SxW7SUGsZKA . Also, an article discussing the connections between her graduate research and the new SARS-Cov-2 variants in which Jesse Bloom, Katherine's PhD advisor, is quoted is accessible at: www.sciencemag.org/news/2020/12/uk-variant-puts-spotlight-immunocompromised-patients-role-covid-19-pandemic .

Of her most recent research, Katherine says: "I am currently a postdoctoral fellow at Stanford University, where I work in the labs of Dmitri Petrov and David Relman. I'm running a study of household transmission of the human microbiome, where I'm trying to understand how our microbial ecosystems are shaped by the people and places around us."

"In my PhD, I studied influenza, a pathogen whose evolution is shaped by conflict with our immune systems. Now, I'm studying evolution in the microbiome, the collection of mostly beneficial microbes that live on and in us throughout our lives. I hope to understand how these microbes evolve and transmit to shape our microbial ecosystems. One day, I hope that this research can help us design more effective probiotics and other therapeutics that allow us to refine our relationships with these microbes."

Her current assignment does not involve another of Katherine's passions, teaching. However, she wrote of her plans: "One perk of being at Stanford, which has a large postdoc community, is that there are dedicated programs where postdocs can learn to teach - a rarer opportunity in academia than we all might hope! I've been working slowly through a teaching certificate here and am enjoying it immensely so far. Our current positions don't involve formal teaching, so there's less practice than might be useful, but I also get to work with grad students in the lab and have been working closely with wonderful undergraduate students as well and am now working with yet another undergraduate, and she is also delightful! So, if the academic winds blow in my favor, I think I'll enjoy the teaching and mentoring as much as the research aspects of being in academia!"

I asked Katherine for her advice to students seeking a future scientific career. Her answer follows: "I recommend that students interested in scientific research seek out research experiences as soon as they can to learn what it's like to work in a lab. At the same time, it's important to remember that lab groups each have their own values and culture, a lot like companies, and it's important to find a place that's a good fit for you. Science is a diverse ecosystem, and there's room for scientists with all kinds of skills, backgrounds, and personalities to bring their unique perspectives to this creative endeavor."

Finally, I asked Katherine to comment on the past, COVID-19 restricted year and the challenges of research during a global pandemic. Her thoughtful reply follows: "As an influenza researcher, I always believed I would experience respiratory virus pandemics during my lifetime, but there was still a huge gap between this abstract understanding and the reality of the unprecedented social changes that this past year has brought. I continue to keep close tabs on the Covid research that my colleagues are doing, but when it comes to the visceral, day-to-day experience of the pandemic, I've had to adapt to the changing circumstances just like everyone else."

"One challenging part of the pandemic for me has been seeing the limits of what science can do. Cutting-edge technologies for virus testing, sequencing, or vaccination are only as good as the public-health infrastructure that deploys

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them. In so many cases during the pandemic, we've had tools to curb the virus's spread, but we've lacked the collective will to use them. This feeling was part of what motivated me to write about the uncertainty of the Covid death toll. ("The Awful Uncertainty of the Coronavirus Death Toll," *The New Yorker*, February 21, 2021) I wanted readers to understand how even a seemingly simple statistic like the death toll is refracted through many layers of translation and interpretation as it moves through our social institutions."

"Science is more social than many people realize, and Covid has made it harder to have the daily scientific conversations and mutually supportive interactions that are part of being in a lab. I was fortunate to move to Stanford and start carrying out my study of household transmission in the microbiome right as the pandemic started, and I've been able to adapt many aspects of the study to continue through this past year. One of the biggest challenges of working in the lab has been supply shortages – I use many of the same lab supplies that are involved in Covid testing, and those supplies are often hard to find! But overall, I've been fortunate to continue carrying out most of my planned research."

As we all hold our breath for the future, and yet, eagerly anticipate a "return to normalcy," it is reassuring to know that one of our own ORHS alumni will be advancing research in human microbiome evolution and continuing to publish informed discussions on public health concerns and policies. Most certainly, I will be following Katherine Xue's future scientific writings as a trusted information source and for her thought-provoking observations on societal implications.

Surely we have just been fortunate to share the story of Katherine Xue and to appreciate her work explaining the intricate world of the coronavirus. Katherine is someone who fosters trust in her research findings because she is well educated in the science needed to comprehend such complexity that to most of us seem so foreign.

Thank you Benita for yet another excellent choice for Historically Speaking readers.



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Katherine and Seungsoo



A selfie of Katherine and Seeongsoo with a Galapagos tortoise