Introduction Holly Krieger

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Ellen de Bruin

Our guest tonight, mathematician Holly Krieger, is someone who came to her profession indirectly. She was born in 1983 in Champaign, near Chicago, where her parents worked at the University of Illinois – her father as a computer programmer, her mother in healthcare. The family moved around the country a bit, lived in North Carolina, the Bay Area, and then settled back in the Chicago area where Krieger started college.

There's a nice resemblance, a symmetry one might say, between that early moving around of the Krieger family and the moving around that Krieger did once she had started her studies. The first major she chose was biology – she was very interested in genetics. But she found out that lab work wasn't one of her talents, and, as she told me, "it didn't help that the lab meetings were on Fridays at 8AM".

So she switched to psychology. And in a way, she is still interested in psychology: she loves to think about the process of understanding mathethematical problems, about the leap from not understanding something to feeling it clicking into place. She also loves to bring that process about in other people, as she does with her public lectures and the YouTube-videos she made for math channel Numberphile. But at college, psychology wasn't for her. It didn't feel exact enough. So Krieger switched to Italian.

Nowadays, she finds it hard to recall why she chose Italian, but she does know that she had actually wanted to switch to Portuguese, because she was in love with fado music, and for some reason that wasn't possible. Krieger liked Italian well enough, but about this point in time she realized, as she told me: "No one would pay me if I had a degree in Italian." So she switched to Computer Science. Still not Mathematics, but we're getting closer!

In Computer Science, Krieger did a math course that she just loved. She had done some mathematics before: analysis, differential equations... But this course was Introduction to Proof, and for some reason she ended up in a more advanced course than she would normally have, and for the first time she felt real passion for a subject.

So that brought about her final switch, the one that has determined her career: the switch to mathematics. She surprised herself that she ended up doing math, but when she went to a high school reunion later on, her former classmates acted as if they had known it all along.

Still, though, Krieger was a bit reluctant about math. People told her that real mathematicians do nothing but math, it is the center of their lives, it keeps them awake at night. And as we have seen, Krieger is not really a one-interest person. She was more social than the average math student in her year. She had a job in a record store that she loved, she worked as a bartender. It was only when she met people who convinced her that people can be successful at mathematics and still have a life outside it, that she felt comfortable pursuing it as a career.

So she went to graduate school at the University of Illinois in Chicago. She did a PhD in arithmetic dynamics. Arithmetic is the study of numbers, in particular prime numbers, as these are the building blocks of numbers by multiplication (every integer has its own unique prime factorization). And dynamics is the study of changes, over time, in a system that is governed by relatively simple rules. The well-known Fibonacci sequence is an example of a dynamical sequence: you start out with the numbers 1 and 1, and the next number is always the sum of the previous two: the sequence goes 1, 1, 2, 3, 5, 8... However simple the rule is, it wouldn't be easy to mentally calculate the 2000th number this way.

Krieger still works in dynamics. She did a postdoc at MIT, where she got involved with a local group of Women in Mathematics, and after that, in 2016, she moved to the other Cambridge, the one on this side of the ocean. She now has a permanent position as a lecturer at the University of Cambridge, where she is also a fellow at the all-female Murray Edwards College. Her research is focused on the dynamical André-Oort conjecture, which is rather hard to describe, but essentially, she told me, it is about modifying the 'normal' André-Oort conjecture to dynamics. We might talk more about this later tonight.

There is a link between Krieger's research and the topic of her talk today: the beauty of symmetry. The Julia sets that she studies, and fractals in general, have the property of self-similarity: if you zoom in, the picture looks the same again, and that is a form of symmetry that is very pleasing. And also, Krieger chose symmetry as the perfect topic to get non-mathematicians to understand the importance of the jump from concrete to abstract. Most people, Krieger says, can do simple calculations, but they will be scare away by abstract variables. They can see that 2 times 3 equals 6, but they will find it much harder to see, in the equation $3x=6$, that x equals 2. By using the intuitively appealing subject of symmetry, Krieger will help us to make that jump tonight.