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Biophysicist in Profile

Karolin Luger

Before *Karolin Luger* was chosen to be the National Lecturer at the 57th Annual Meeting of the Biophysical Society, before she completed a postdoc or got her PhD, before she completed high school at a ‘garden-variety’ gymnasium in Austria, she was the youngest child, feeling a little left out of the lively discussions between her electronics- and physics-inclined brothers and father. As family lore would have it, math and physics were ‘not her thing.’ But for a love of nature—which started with a childhood fascination with planting seeds and looking at things under a microscope, and came to fruition in a middle school biology class when she asked how RNAs were connected with the correct amino acids and “didn’t get a very clear answer”—Luger might have chosen a different path. As it was, however, “that class was when it dawned on me that not everything was ‘known’ yet,” she said, and headed for a scientific career.

After completing gymnasium with a specialty in foreign languages, Luger attended the University of Innsbruck. “The only way to study biochemistry was through a chemistry degree,” said Luger. Given her interest in nature, she went for a degree in microbiology with an emphasis in biochemistry instead. With a Master’s degree in biochemistry under her belt, Luger moved to Switzerland to attend the Biocenter at the University of Basel to work on her PhD. Finishing her PhD in biochemistry and biophysics with ‘great colleagues and a wonderful mentor’ kick-started her rise to success.

As a graduate student, Luger took an advanced lecture course on x-ray crystallography. “The lectures were excruciatingly boring,” she said. However, she was intrigued by the beauty of diffraction patterns and how they could provide information on

structures, so Luger dedicated her postdoc with *Tim Richmond* at the University of Basel to learning crystallography. Her postdoc experience was longer than expected, as she picked a difficult system to work on, but remained “blissfully ignorant of that fact until I was way too deep into it.” After overcoming the challenge of obtaining diffracting crystals and solving the phase problem, “I spent a rather lonely year in a dark airless room, hand-building a very large model on a very slow computer. After that,” Luger reflected, “everything else seemed comparatively easy – starting my lab, getting grants, even solving more structures.”

Would she recommend that new scientists start with a tough challenge? “While it may have worked for me, it could certainly be dispiriting for a young researcher,” she said. “It depends on the type of person you are.” Knowing when to push forward and when to call it quits has been an ongoing challenge for Luger. “It can be difficult to remain optimistic when a long-term project isn’t going so well, and even more difficult to decide to ‘pull the plug,’” said Luger.

While completing her postdoc, Luger gave a talk on the x-ray crystal structure of the nucleosome at the Cold Spring Harbor Meeting on Mechanisms of Transcription. Her future colleague, *Laurie Stargell*, then an assistant professor

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– Karolin Luger

at Colorado State University (CSU), met Luger at the meeting and described the talk and paper that came out of it (published in *Nature*) as “classic in every sense of the word.” At the time of the talk, the nucleosome was the largest and most complex protein-nucleic acid assemblage to be crystallized, and it came at a critical time in chromatin research, just as nucleosomes were being acknowledged as important regulatory components of genes. “The information obtained from the crystal structure of the nucleosome,” Stargell explained, “propelled the re-emergence of chromatin as a highly significant field of study.”

The ground-breaking nucleosome paper was also the first time Luger appeared on the radar of Biophysical Society President *Jane Richardson*, who named her National Lecturer for the 2013 Annual Meeting. “Karolin gave a gorgeous talk at the 2011 Nucleic Acids Gordon Conference,” said Richardson. “Her talk was well-presented and had a take-home message that many, especially young biophysicists, could appreciate.”

Her diverse background—“I specialize in not specializing too much,” according to Luger—has helped her keep an open mind to using a variety of approaches to answer questions. Moving from DNA sequencing (when there were no facilities to do it) as an undergraduate to protein folding, enzymology and spectroscopy as a PhD student, followed by x-ray crystallography as a postdoc, has brought her to understand and respect many different ways to solve problems. As a favorite she chose the high-resolution electron density map of a new protein complex. “It is thrilling to see, for the first time, how it all fits together,” she declared, “The beauty of structures and their intricacy still takes my breath away. I’ll never get tired of that.”

Now a Howard Hughes Medical Institute Investigator and a Distinguished Professor at CSU, her research focuses on investigating the assembly and disassembly of nucleosome structure by a group of proteins known as histone chaperones. Her lab also works on proteins that shape chromatin architecture by interacting with nucleosomes, as well as the effect of histone post-translational modifications and histone variants on nucleosome and chromatin structure. “It is such a fun set of projects,” Luger said, “every

project in the lab is tightly interconnected with almost all other projects—histone chaperone function is affected by histone post-translational modifications; chromatin architectural proteins affect nucleosome dynamics... and more.”

Luger counts collaboration among one of the most rewarding aspects of her work. “Collaborative projects force me to think outside the box.” Her current projects involve interacting with three separate research groups, who are all tackling the same questions with different approaches. Also top on her list of perks? Getting to be a geek. “I love the sheer geekyness of biophysics,” Luger admits, “all the shiny and complex equipment, applying many technologies to answer a question, and sometimes ‘tricking’ the system by devising approaches to study aspects of macromolecules or assemblies that aren’t inherently accessible to being studied.”

Stargell, now a professor and associate chair at CSU, has worked with Luger extensively since 1999 sharing several publications, working together as PIs/co-PIs on various grants, and presently working together. “Karolin is an absolute joy to have as a colleague,” says Stargell. “She is a thinker and a doer, who constantly pushes the envelope of chromatin research using a wide range of approaches.”

Luger is “so thrilled to have the opportunity” to be the National Lecturer at the Annual Meeting. “I am tempted to take a picture of the audience from the podium,” she said. “I think this will be the largest number of biophysicists in one room I’ll ever see!” Luger is honored to be included on the list of National Lecturers, remembering *Roger Kornberg’s* talk as an inspiration to a (then struggling) structural biologist.

Outside of the lab, Luger enjoys gardening. In her small garden, she grows lettuce, tomatoes and squash, and says that had she not become a scientist, she might have a very different career today. “If I had a smidge of talent at piano, I might have done that,” she joked, “But since I definitely don’t, I would enjoy running an organic farm.” She also enjoys reading fiction, and spending as much time outdoors as possible with her husband, daughter, and two dogs. “Living in Colorado, there’s always hiking, snowshoeing and camping—although not nearly enough!”



Hiking in Telluride, Colorado, with husband Matt and daughter Maya.



Combining a career in science with family life and outdoor activities is a balancing act, as is ‘slack-lining’, a rather addictive form of exercise.