



A Train Without A Brake: Dr. Danith Ly

By Hannah Diorio-Toth

Danith Ly, like most Carnegie Mellon faculty, wears many hats: researcher, professor, businessman, husband, humanitarian and survivor. Beneath this surface is a tortuous journey which fuels a fiery passion both inside and outside his Mellon Institute chemistry lab.

"I remember this little child vividly, she must have been three-years-old — a young girl wearing a white shirt, blue dress. She was crying, holding onto her mother who was dead on the side of the road. And ever since, when I feel tired, I think of this little girl. Every day I wonder where she is now. Did she survive?"

The question has always been about survival for Danith Ly, who grew up in Cambodia during the height of the Cambodian-Vietnamese War and Cambodian Genocide. It is estimated that two million people were killed by the Khmer Rouge Communist group.

Now an Associate Professor of Chemistry at Carnegie Mellon University, Danith strives to make a positive impact through his work by focusing on solving real-world problems. He designs and creates novel molecules that have broad applications in the treatment of infectious disease, cancer, and bacterial infections.

"The ultimate goal is to put an end to, or lessen the severity of suffering, in whatever shape and form. I want to try to educate people, especially the young ones, so that they become future leaders of tomorrow and they don't function like these... [oppressive] people," Danith says as he leaned forward into the conversation.

This goal comes alive in Danith's research and humanitarian work. His struggles have given him a unique perspective on life and serve as the underlying source of his daily stamina and motivation. In Danith's own words, "Once a person is inspired, it's like a train without a brake."

FROM REFUGEE TO PH.D.

After almost ten years living under the reign of Pol Pot and the Khmer Rouge, Danith and his mother were given the chance to immigrate to the United States in 1984. Danith's uncle, a member of the Cambodian Navy training in the United States, acted as the family's sponsor.

With no previous schooling in Cambodia, Danith began his education in the United States as a seventh grader at Longmont Junior High School in Longmont, Colorado. He was placed into the school system according to his age of twelve, not his educational background—zero. Prior to coming to the United States, Danith explains, "All of us were out in the field working in labor camps from dawn to dusk and were lucky to be alive."

Danith did not speak any English and Longmont Junior High School did not have any existing English as a Second Language programs in place at the time. He and his cousin were some of the only foreign students in the school. "We were sort of on our own," Danith remembers.

This was the case for many Cambodian immigrants. In fact, before 1975 almost no Cambodians lived in the United States, so very little support existed for these refugees. Cambodians like Danith began

immigrating to the United States in large numbers in the early 1980s during the Cambodian-Vietnamese War.

Danith says that he still has nightmares about starting school in the United States. Laughing and burying his face in his hands, he explains, "Oh my god! I mean, everything was just so tough. People want to be friends with you but they don't know how to communicate with you. So we ended up using a lot of sign language to try to communicate."

He learned English with the help of better language programs in Florida, where he moved for high school when his mother remarried. Florida was home to a larger settlement of Cambodians, which empowered Danith with a stronger sense of identity and community.

It was in high school that Danith began to connect with science. Forced to mature at a young age, he recognized science as an opportunity that would allow him to improve society. "I wanted to come up with a theory, a philosophy. How do we build a society that would be closer to a utopia? You know, something opposite from where I came from."

Danith went to Georgia Institute of Technology in 1990, planning to pursue Aerospace. He switched his major from Aerospace to Chemical Engineering after finding out that he was unable to work for NASA without United States citizenship. "I thought about applying for it then, but it would take another year or two just to hear from them, and by that time I would have graduated or dropped out of school due to my inability to pay tuition," Danith explains. The process is an expensive one and finances were low even with working two jobs on top of his studies.

Feeling lost, Danith decided to find his next academic pursuit by asking his

professors and advisors what they felt the most difficult major was at Georgia Tech. "If they had said 'underwater basketweaving,' I would have taken it." Danith laughs, "I was determined to take whatever they told me." Their answer of "Chemical Engineering" shaped much of Danith's academic future.

After graduating with a Bachelor of Science in 1994, he stayed at Georgia Tech and went on to get his Ph.D. in Chemistry. Under the direction of Dr. Gary Schuster, Danith truly began to define his research interests in organic chemistry. "He was telling me about working with a biomolecule called DNA and looking at this thing called an electron and how fast it was traveling," Danith recalls with a smile.

When Dr. Schuster told him about the speed of travel, femto-second, Danith could explain it in one way: "mind boggling."

Eager to work with Dr. Schuster, Danith applied

his determination and strong-willed focus to his projects. When Dr. Schuster asked Danith if he knew anything about the project he had requested to work on, "I said 'no, but I'm willing to work 24 hours-a-day, whatever is necessary.'"

MAKING HIS MARK

Intellectuals were among the largest targets of the Cambodian Genocide. "They kill off the intellectuals because those are the rebellious ones, and they keep all of the illiterate people because it is easier to tell them what to do," Danith explained with a short exhale.

Now an Associate Professor in the Chemistry Department, Danith sees his career as an opportunity to make a mark on the world. "Once you go to school and become educated, I think you assume more responsibilities—not just what's in your surroundings, but for humanity. Because, you know, the place is so small...we are

only just one small blue planet."

Danith's research focuses on finding solutions for huge challenges in the treatment of disease. At the core of his work is the fundamental lesson of DNA. "Genetic information in most organisms is encoded in DNA. Depending on what genes are turned on or off will determine life or diseases," Danith explains. "So if you can design a molecule that will bind to any sequences of that code, that blueprint, you can control the flow of that information. You can control what genes are turned on, and therefore, you can treat diseases."

One such molecule that Danith and his collaborators have created is called gammaPNA, or gamma peptide nucleic acid. GammaPNA can enter the cell and bind to certain parts of the genetic sequence, controlling the flow of information.

"I see it like a pothole in the road. So, how do you fix that little pothole and not another? You just have to make something with the right shape to fit. And then that thing can be changed slightly to fix the second pothole, assuming you have all of the material."

Danith and collaborators are now working to fill that second pothole. With the support of a recent \$3.1 M grant given to the Center for Nucleic Acids Science and Technology (CNAST) by the David Scaife Family Charitable Foundation, Danith will work with the Center on the research and development of a second molecule, called JanusPNA.

"By the end of this [grant], it's either that we are going to get something really big and we are going to put CMU on the map," Danith says before pausing to correct himself, "not that it's not already on the map—but let's make it bigger! If not, we are going to tell them, don't come this way, it doesn't work."

This grant is a unique opportunity for Danith to test these new ideas and to continue to develop this technology with CNAST. If successful, this research can have powerful applications in the treatment of diseases like amyotrophic lateral sclerosis (ALS) and Huntington's disease. However, the applications are thought to be wide-reacting. "I have been very fortunate that I have this dream, and now [the

David Scaife Family Charity Foundation] is providing the financial support to really test it," Danith says.

Despite the immensity of the tasks that lay ahead of Danith in his research, his difficult journey growing up helps him to never lose perspective. "I worked so hard when I was little. So, putting 16-18 hours a day is nothing to me. And the students and postdocs... they want to do the same. "

WORKING FOR CHANGE

Even with spending 16-18 hours a day in the lab, Danith still finds time to give voice to the struggles of his fellow Cambodians. Today, Cambodia still suffers from government corruption and many human rights issues. Among the poorest countries in the world, it is estimated that one third of the Cambodian population live on less than a dollar a day.

Danith and his wife, Many, work with a Chicago-based organization to raise money to loan to Cambodians on a short-term basis. By loaning them the money instead of just sending them funds, Danith feels that the organization is helping Cambodians to help themselves. "I believe that if you empower them, they will do something bigger."

Danith and Many also travel to Washington D.C. to participate in demonstrations and other events to raise awareness about the struggles of the Cambodian people, calling on the help of the United States Congress.

When asked how he meshes his humanitarian efforts with his academic responsibilities and research, Danith is quick to respond that the two are separate parts of his life. He sees his humanitarian work as a personal crusade that he does not bring into his professional career. But the unifying factor in both aspects of his life is that Danith has one driving goal—to make a difference. And it is clear that he uses his passion and unwavering ambition to work towards this goal in all that he does.

"Our [my and Many's] goal is to be able to bring awareness to the plight of some of these people. We want happiness and family for everyone."

A COLLECTION OF MEMORIES

When Danith is not in the lab or in at a demonstration in the streets of Washington D.C., he spends his time teaching in the Mellon College of Science and acting as the Executive Director for a biotechnology company he co-founded with Carnegie Mellon's Dr. Bruce Armitage. And while juggling all of those activities, he is sure to maintain his focus on his family.

How does he balance everything?

"I try to be a good person first and foremost and the rest follows....[My wife] is very supportive of me, because she understands the reason why I am doing what I'm doing."

Also a Cambodian immigrant, Many not only understands, but also has a deep connection to Danith's daily motivation.

It seems as though Danith and Many have the past steadily pushing them forward towards a bright future. "I tell my wife all the time that life is about a collection of memories. You try to collect as many good memories as you can and hopefully you can pass it on." ■