

In pursuit of waves

Passion for science and technology can be a powerful motivator to overcome hurdles, as **Nader Engheta** explains, recounting his own experience as an immigrant.

My love for waves started in my youth when I was a high-school student in Tehran, Iran. As a child, I was always curious and interested in finding out how things worked. One day while one of my older brothers, Iradj, was disassembling a battery-operated transistor radio I asked him: “How does this radio work without being connected to anything?” He told me that there was indeed a wave ‘connecting’ the radio station to the radio, and that was how a signal was getting into it. I instantly became fascinated with waves. And that fascination propelled me into a life-long journey that took me from my country of birth, Iran, to my country of residence, USA, in pursuit of the science and technology of electrodynamics and optics.

A few years later as I was finishing my undergraduate study at the University of Tehran’s school of engineering (known as Daneshkadeh-e-Fanni) I became determined to pursue my higher education in the study of waves. However, in those days there was no PhD program in science and engineering in Iran, and therefore I had to travel to another country for this purpose. But another major event was brewing in Iran at that time — the 1979 revolution. I left Iran in the summer of 1978, and went to Caltech in Pasadena, California for my master’s degree and PhD.

Both Caltech and the University of Tehran have special places in my heart, as they had significant impacts on my way of thinking about science and technology. The University of Tehran taught me the fundamental elements of mathematics and engineering, and Caltech taught me advanced topics in science and technology, but more importantly, it taught me the way of doing science — how to think scientifically, how to be courageous when approaching unknowns and to push the frontiers of knowledge, and how to explore and develop new scientific territories and domains.

But there was another important lesson I learned from my education at Caltech, namely, the humanity and humility of the professors I had the fortune to come to know while I was a student there.

Scientific giants such as Richard Feynman, Max Delbrück, Charles Papas (who was my PhD supervisor), and many others all showed generations of students how to be a scientist and a humble person. These brilliant scientists were all at the pinnacles of their respective fields, and yet they were modest and down to earth. They loved exploring and discovering the foundations of their fields and educating students, and, by their examples, they demonstrated how to value humanity. Let me give you an example.

In February 1979 when the revolution happened in Iran, I could not communicate with my family back home due to the interruption of the phone and mail services there. One day, my advisor at Caltech, Professor Papas, took me aside and asked me about the situation in my home country and how my family was coping with the events there. He was a worldly and knowledgeable man, and he knew how I must have felt as a young man in a new and faraway country, worrying about my family in the midst of a revolution. He tried to comfort me by saying that they would be fine and then he told me the following words, which I will always remember for the rest of my life. He

said: “I know you worry about your family and you miss them. But please consider my family as yours. As long as I am alive, you will be part of my family, and we will take care of you.” You cannot imagine how comforting and reassuring those words sounded then and still do. He was always a source of wisdom and kindness for me for the rest of his life until his death in 2007.

Any immigrant knows that immigration is not easy. It is full of adventures, hardships, frustrations, and rewards. But those very attributes teach us how to be resilient, how to face challenges and overcome difficulties, and how to apply these experiences to other endeavours in our lives, including pursuing science, which rewards us with its wonderful attributes. For one, we make friends with scientists from all over the world, and our lives become enriched by the diversity and beauty of various cultures. Any scientific conference brings together scientists of many different cultures and nationalities in a common pursuit of knowledge. Scientific communities have always benefited from immigrants, and therefore the free movement of scientists, which is one of the important factors in scientific development worldwide, should be strongly supported.

As a principal investigator now, I understand that a student, a postdoc or a young faculty member can be anxious about their future career in science and technology as many unknown challenges lie ahead. I tell them to follow their passions, as science and technology are so exciting and invigorating. “If you love what you do,” I tell them, “sooner or later you will overcome hurdles and will get to your goals.” The joy of discovery is a powerful engine that propels scientists to the next stage of their journey. The ‘ups’ and ‘downs’ of the scientific process teach us how to gain experience and how to move forward. Frustration and failure are part of the learning process on the path to discovery. □

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The author with Richard Feynman at Caltech in 1982.