Lasers, Fiber Optics, and Endless Opportunities

Caltech’s groundbreaking research has given rise to countless companies over the years. One remarkable success story is Ortel Corporation, which was founded in 1980 by Amnon Yariv, Martin and Eileen Summerfield Professor of Applied Physics and Electrical Engineering, and his group members Nadav Bar-Chaim and Israel Ury. The company was a pioneer in the development of semiconductor lasers for fiber-optic communication and was eventually acquired by Lucent Technologies. It subsequently spun off to become a division of Emcore Corporation and remains a prominent supplier of high-performance microwave optoelectronic components and fiber systems for the cable, wireless, and satellite communication industries.

ENGenious: What inspired you to become engineers? Hank: I was always intrigued with trying to make things. Figuring out how to use technology to solve problems is challenging, interesting, and rewarding.

Nadav: I actually wanted to become a physicist. But when I went to do my PhD, the school of engineering was new and had sort of an unlimited budget.

ENGenious: How did you come to join Professor Amnon Yariv’s group at Caltech? Kam: I actually came to Caltech fully intending to major in aeronautics. In high school, I had read a biography of Qian Xuesen, the father of Chinese rocketry and a Caltech alum, and I was inspired to follow in his footsteps. But I was coming from Hong Kong, and I soon learned how difficult it would be to get an aeronautics job in the U.S. as a foreign student. So I decided to do something more practical. And that’s how I ended up in electrical engineering. Right away I was impressed by the off-the-scale caliber of the faculty. Early on, I connected with Professor John Pierce (BS ’33, MS ’34, PhD ’36), a Caltech alum who had been an executive director at Bell Labs, famed for leading the first satellite transmission demonstration in the 1960s. He came back to teach at Caltech in the 1970s, and it was through him that I got a chance to do research at Bell Labs during the summers of my junior and senior years. It gave me a taste for research and hooked me into the field of optical communication. Coming back to Caltech in the fall, I showed Amnon my work at Bell, and he was impressed enough to invite me to join his group to work for a PhD.

Hank: I was primarily attracted by the work they were doing on lasers. This research would be useful for fiber-optic communication, and it was a topic of particular interest to me. In addition, Amnon was able to put together a tremendous group of graduate students and postdocs, which made it a great environment to learn and develop your skills.

ENGenious: Tell us the story of Ortel. Kam: Back in the 1970s, there were already a couple of companies building semiconductor lasers. To make them practical, we had to make them last continuously at room temperature. So this was the main goal of our work in Amnon’s group at that time. Nadav filled the important role of making the first continuously operating laser in our lab. Then Amnon asked me to look into how fast we could modulate it; that is, how to make a laser that could be modulated faster than anyone else could do it. At the time, the fastest speed anyone had was a few megahertz. Nadav and I collaborated on a semi-conductor laser directly was stuck at about 1 to 2 gigahertz. No other company at that time could make lasers that could be modulated faster than anyone else could do it. We were actually the first to show the cable companies that you could do high-speed lasers. We had the fastest speed lasers. And Hank joined later but eventually got involved in almost everything.

Hank: I joined in 1985. At that time, I was working on lasers with longer wavelengths—1.3 or 1.5 microns—which are outside the visible spectrum but work very well for transmitting signals through optical fibers. These signals can travel much longer distances than shorter wavelengths. I was still a graduate student when Ortel started. I was aware that starting a company was being explored, but I was not involved in the founding of Ortel.

ENGenious: Can you tell us a little more about the impact of Ortel’s technology? Hank: Ortel’s main niche was making lasers that could reduce the complexity of optical fiber modulation, and no longer existed as an independent company.

Nadav: We were actually the first to show the cable companies that you could do high-speed lasers. We had the fastest speed lasers. And Hank joined later but eventually got involved in almost everything.

ENGenious: What inspired you to become engineers? Hank: I was always intrigued with trying to make things. Figuring out how to use technology to solve problems is challenging, interesting, and rewarding.

Nadav: I actually wanted to become a physicist. But when I went to do my PhD, the school of engineering was new and had sort of an unlimited budget.

ENGenious: How did you come to join Professor Amnon Yariv’s group at Caltech? Kam: I actually came to Caltech fully intending to major in aeronautics. In high school, I had read a biography of Qian Xuesen, the father of Chinese rocketry and a Caltech alum, and I was inspired to follow in his footsteps. But I was coming from Hong Kong, and I soon learned how difficult it would be to get an aeronautics job in the U.S. as a foreign student. So I decided to do something more practical. And that’s how I ended up in electrical engineering. Right away I was impressed by the off-the-scale caliber of the faculty. Early on, I connected with Professor John Pierce (BS ’33, MS ’34, PhD ’36), a Caltech alum who had been an executive director at Bell Labs, famed for leading the first satellite transmission demonstration in the 1960s. He came back to teach at Caltech in the 1970s, and it was through him that I got a chance to do research at Bell Labs during the summers of my junior and senior years. It gave me a taste for research and hooked me into the field of optical communication. Coming back to Caltech in the fall, I showed Amnon my work at Bell, and he was impressed enough to invite me to join his group to work for a PhD.

Hank: I was primarily attracted by the work they were doing on lasers. This research would be useful for fiber-optic communication, and it was a topic of particular interest to me. In addition, Amnon was able to put together a tremendous group of graduate students and postdocs, which made it a great environment to learn and develop your skills.

ENGenious: Tell us the story of Ortel. Kam: Back in the 1970s, there were already a couple of companies building semiconductor lasers. To make them practical, we had to make them last continuously at room temperature. So this was the main goal of our work in Amnon’s group at that time. Nadav filled the important role of making the first continuously operating laser in our lab. Then Amnon asked me to look into how fast we could modulate it; that is, how to make a laser that could be modulated faster than anyone else could do it. At the time, the fastest speed anyone had was a few megahertz. Nadav and I collaborated on a semi-conductor laser directly was stuck at about 1 to 2 gigahertz. No other company at that time could make lasers that could be modulated faster than anyone else could do it. We were actually the first to show the cable companies that you could do high-speed lasers. We had the fastest speed lasers. And Hank joined later but eventually got involved in almost everything.

Hank: I joined in 1985. At that time, I was working on lasers with longer wavelengths—1.3 or 1.5 microns—which are outside the visible spectrum but work very well for transmitting signals through optical fibers. These signals can travel much longer distances than shorter wavelengths. I was still a graduate student when Ortel started. I was aware that starting a company was being explored, but I was not involved in the founding of Ortel.

ENGenious: Can you tell us a little more about the impact of Ortel’s technology? Hank: Ortel’s main niche was making lasers that could reduce the complexity of optical fiber modulation, and no longer existed as an independent company.

Nadav: We were actually the first to show the cable companies that you could do high-speed lasers. We had the fastest speed lasers. And Hank joined later but eventually got involved in almost everything.
internet rather than supplying TV channels, but Ortel’s laser technology has remained crucial.

**ENGenuine**: What are your favorite memories of your time with Amnon and the group?

**Hank**: My best memories from my time at Caltech are about the collaborative environment that existed in Amnon’s group. There was a large group of graduate students and postdocs working to better understand the emerging field of semiconductor lasers, but for the most part we were working on independent projects. This resulted in a very high level of constructive interactions and discussions with minimal competition for credit for the results. I found it to be very favorable for learning.

**Kam**: I remember being extremely protective of my experimental setup. I used to plaster threatening signs all over my microwave measurement equipment: “DO NOT TOUCH!” “DO NOT MOVE!” “DO NOT LOOK!” “DO NOT BREATHE!”

**ENGenuine**: How is a Caltech education viewed in your industry?

**Hank**: Caltech is small, but in every area where it’s heavily involved, its researchers are viewed as leaders. Especially people like Amnon who have such high standing in the scientific and engineering world. That affords Caltech students really well known and respected in the field of fiber optics and optoelectronics. When I was working in his lab, we constantly had recruiters from industry visiting our group. His students were hotly pursued as soon as—or even before—they graduated, and each of us got multiple job offers. This is a testament to how valuable a training in Amnon’s group was regarded in industry, and still is today.

**ENGenuine**: What advice do you have for current Caltech students?

**Nadav**: Keep an open mind in what you do. Don’t get married to a specific idea—if it doesn’t work out, just go around the corner and try something else. And be a team player. For practical work, it’s much easier to accomplish things in teams.

**Hank**: Learn as much of the conventional wisdom and theory as possible, but realize it’s always incomplete. Progress comes from finding what’s wrong with or missing from the conventional wisdom. When things don’t go as expected, those surprises often lead to whole new areas of study.

For more than 100 years, the Caltech Y has engaged Caltech students in a wide variety of programs and services that create opportunities for adventure, leadership, and service. The activities and events offered are student-driven, and remarkable programs have emerged over the years. One shining example is the Rise Program, a low-cost after-school tutoring program in math and science in which Caltech undergraduate and graduate students tutor public-school students between grades 8 and 12. Another is the Student Activism Speaker Series (SASS), the student-run lecture series. And, last but not least, the Y is still the place to go to rent camping equipment!

**ENGenuine**: What is the role of the Caltech Y?

**Athena**: The Y’s mission complements Caltech’s mission—we help to create citizen scientists. Part of what we do is present current issues to students and challenge them to become involved. By inviting speakers to campus...