Remembrances of Spectra-Physics

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It was a cold February morning in Minnesota—really cold! The year was 1963 at the Honeywell Research Center, and the author, only recently graduated from college, helped some visitors bring in their product to demonstrate. Herb Dwight, one of the five founders of Spectra-Physics, and Gene Watson, their star salesman, had stayed overnight in Minneapolis and left their laser in the back of a station wagon. When their Model 110 He–Ne laser was brought into the lab, "steam" was pouring off every surface, befitting the change from below zero to room temperature. The unit was turned on and, miracle of miracles, a sharp red 632.8-nm beam emerged. It does not seem like much now, but the author was blown away—having only too recently tried to build such a laser himself. With the optics of the time and his limited understanding of the process, achieving the necessary alignment proved difficult indeed. And here were these guys, tanned by the California sun and braving the frigid temperatures, showing us pallid northerners in the depth of winter a commercial product that worked.

Some months later, convinced that he wanted to join the world of lasers, the author headed west to join the company. Just before he set out, a call came in requesting that he stop at the JILA lab in Boulder, Colorado, to demonstrate a laser to Dr. John Hall, a future Nobelist. That laser, drop shipped to the author in Denver, did not work. It turned out that the power supply "on" switch was not wired in and the author was too clueless to determine the problem. The next day another laser arrived and was demonstrated to Dr. Hall and his staff, thus completing the author's first sales call.

Early Spectra-Physics lasers consisted of a tube filled with a He–Ne gas mixture at a pressure of a few Torr placed in an optical cavity with mirrors at either end and a power source, which was radio-frequency (RF) coupled into the gas. Radio-frequency coupling avoided the necessity of placing anodes and cathodes in the tube itself; cathodes available at the time quickly deteriorated, and the tube would go from a healthy pink glow to a sickly blue—death by gas poisoning!

The Model 130 was introduced in 1963, a foot-long ten-pound laser that looked for all the world like a lunch box complete with leather handle. Cost considerations demanded that DC power be used instead of RF coupling. The tube was terminated with optical windows set at Brewster's angle, and the confocal mirror cavity was protected from the outside world with flexible rubber boots. The problem was the cathodes were "borrowed" from neon sign technology and were designed for use at pressures 10× that of the laser tube. These little metal tubes, terminated with a ceramic disc and filled with some rare-earth oxide mixture, simply did not last very long; the neon was quickly "sputtered" away, and a few-hundred-hour lifetime was considered good. What to do?

The author's bosses, Arnold Bloom and Earl Bell, asked him to follow up on a paper by Urs Hochuli of the University of Maryland in College Park describing aluminum cathodes for use in He–Ne lasers. This assignment led to the author's first real project at Spectra. A visit to Hochuli in College Park resulted in Spectra's machine shop fabricating a few aluminum cathodes, tubes a few inches long and an inch in diameter, allowing some He–Ne tubes to be made. The results were very promising. So promising, in fact, that in a few months, the neon sign cathodes were abandoned and only aluminum cathodes were used. Some 50 years have passed, He–Ne lasers are still being manufactured, and to the author's knowledge aluminum cathodes remain the standby.

That technology became the Model 130, which had quite a long life as a Spectra product. Early devices delivered about 0.5 mW at 632.8 nm; they cost $1525, a solid value at the time, although today a laser pointer producing much more power can be purchased for a few dollars. The Model 130 found many applications, ranging from serving as a pointer in Arthur Schawlow's lecture room to guiding a gigantic borer with a ten-foot-diameter cutting face in a tunnel being drilled through a hillside in Llanelli, Wales.

Spectra-Physics was a wonderful place to "grow up" in the laser world. The five founders provided leadership, presented real opportunities to those younger and dumber, and created an enjoyable work environment. As an example, when it came time to crate the hundredth laser for shipment, work was halted, a keg of beer was produced, significant others were invited, and the factory floor witnessed a party celebrating the event. Now, when millions of lasers in thousands of different configurations are produced worldwide, it is fun to remember when coherent light was rare and customers clamored for the first chance to employ it in their experiments.

Spectra-Physics was also a place where the workdays seemed to run on forever—it was the employees' choice to work overtime, not a company demand. The author recalls fiddling in his lab late one night in 1964 when Earl Bell, a company founder, called out and asked him to come next door to his lab. He had a three-meter-long, large-diameter laser tube attached to a vacuum system and fitted with various gas sources. As usual, he was experimenting with different gases to investigate their laser potential. There was a very bright beam coming out of the tube and Earl asked what color it was. The answer was obvious—a very intense green! Earl said, "I thought so but couldn't really tell as I am quite color blind!" Thus the author was the second person, after Earl, to see an ion laser—a mercury-ion laser. The gain was amazing—Earl took a Kennedy half-dollar out of his pocket and held it in the mirror position at the end of the tube, and the laser flickered on and off as he brought the "mirror" into alignment.

After Earl's discovery, Bill Bridges at Hughes built a pulsed argon-ion laser. Earl quickly followed, and soon the continuous wave argon-ion laser, now ubiquitous, came on the scene. Spectra quickly commercialized it with the refrigerator-sized Model 135 argon-ion laser and power supply. Only a few dozen were made; they were RF-coupled, temperamental, and short-lived. The author remembers many miserable days at a Paris university trying to coax usable power out of one of these monsters during the dog days of August 1968, when all the more intelligent Parisians had left town for the seaside.

Spectra-Physics actively sought to sell their lasers in Europe from very early days. They employed a salesman stationed in Switzerland who visited universities and company laboratories, selling many large He–Ne lasers at prices favorable to the company. However, there was a problem: European countries had firm tariff barriers that greatly increased the costs of buying American lasers. The solution was to set up manufacturing inside the tariff borders. When Herb Dwight asked if anyone was interested in setting up such an assembly operation, the author quickly volunteered and, in a couple of months, moved to Scotland with his small family to do so, choosing a site in Glenrothes Fife, just north of Edinburgh. With the help of the Spectra team, friends of Herb at the local Hewlett-Packard factory, Scottish government representatives and a host of others, Spectra's first Scottish-built Model 130 was shipped three months later, in late 1967. During three years based in Scotland, the team demonstrated and sold Spectra lasers throughout Europe, from nearby England to far-off Athens and north to Stockholm. It was a great adventure!

Back to Mountain View, California, and the author had a new assignment to be product manager for the Spectra-Physics Geodolite Laser Distance Rangefinder, working with Ken Ruddock, one of the five company founders. The Geodolite was based on a 25-mW He–Ne laser that was amplitude modulated at five different frequencies while the return from the target was phase-detected. A one-inch telescope broadcast the beam, and an eight-inch Cassegrain telescope gathered the return signal.

The team used the Geodolite for several ground-based and aerial applications, including ice roughness measurement and wave height determination from various air platforms including a Lockheed TriStar, Convair 990, and Douglas DC-3. For the author, it was the travel gig of a lifetime. He was was in Barbados with the BOMEX project and a NASA team when Neil Armstrong landed on the moon. Unfortunately, there was no live television feed to the island, so the team listened on the radio and celebrated with the local brew! As an aside, the very next day Thor Heyerdahl pulled into

Bridgetown Harbor after having been rescued from the failed Ra rafting attempt across the Atlantic, and the team was there to greet him. Other remote sites visited with the Geodolite included Ireland, the Shetland Islands, Hawaii, the north slope of Alaska, and Brazil. On the ground, the team used the Geodolite to survey in the primary markers for the Batavia, Illinois, accelerator.

Ken Ruddock was a great director and a lot of fun to work with. The Spectra team was testing the Geodolite in airborne applications using the open cargo bay of a rented DC-3 on a hot day flying over the central California valley. Unfortunately, the plane was owned by a chicken raiser, who used it to ship many thousands of baby chicks from his farm to customers located all over the western United States. These chicks leave a powerful odor, which was endured for many flight hours, but there was compensation: the team was on one of those flights the day Spectra-Physics became a public company. Ken turned to the author and said, "I think I have just become a millionaire!"

The author also worked for Bob Rempel, a founder and our first president. Bob was a Ph.D. physicist by degree but a tinkerer and mechanical engineer in his heart. He had strong ideas as to how products should be built and expected all those in his sway to follow his lead. The author's favorite vignette about Bob was his deep love of the Allen head bolt. Such fasteners were used in every possible configuration in all Spectra products. Of course, to use such a bolt, one needed to have the correct Allen head driver on hand. Somehow they were never at hand, and this dearth of drivers drove Bob up the wall. One day, in a fit of pique, he showed up in the lab areas with many boxes of these small drivers and scattered them loosely over every conceivable work surface. With a satisfied smile, he took his leave, saying as he left, "there, that should fix the problem!"

Life at Spectra-Physics was full, challenging, and instructional. The author worked at one time or another for each of the five founders. Though young and dumb, he was treated as an equal partner and was generously given the right to make mistakes and the encouragement to contribute ideas and energy to build a successful Spectra-Physics. The founders of Spectra-Physics are owed a debt of gratitude that cannot be fully paid off.