

Editorial

## The arts and sciences of Lawrence Stark

Larry Stark will be long remembered in the scientific community for his pioneering work in Bioengineering. From his early work applying control theory to physiological motor systems to his seminal development of the scanpath, his ideas have been marked by innovation and imagination. His work in science is well documented in over 300 scientific papers now being collected at the library of the University of Illinois at Chicago. But to those of us fortunate enough to have known Larry on a personal level, he was much more than a scientist. His extraordinary range of interests, the depth and breadth of his knowledge, and his passion for living were inescapable and infectious. The strength of his passions drew us inevitably into his world, and once there, we were irreversibly changed. It is impossible to capture in this short paper even a tiny slice of what Larry was. His scientific writings speak for themselves but here we, his former students and friends, can share some of the things we experienced or learned from this remarkable human being.

His greatest passion was for people: his friends, colleagues, students, and especially his family. Anyone who spent time with Larry would quickly become intrigued, even a little disoriented, by his engaging, multi-faceted, and complex personality. Because he was interested in everything and especially in people, a first encounter with Larry included a gentle probing about origin, culture, and profession, but always in a non-inquisitorial way, with warmth and charm, and seduction when needed. This intense interest in people enabled Larry to make and keep many friends spread over most of the globe. With his extensive network, he could travel the world for months staying only with friends. In his travels, he rarely stayed at hotels, partly because he disliked hotels, but mostly because he enjoyed the companionship of his friends and the celebrations, reunions, and parties that often accompanied a visit from Larry, Photo 1.

Larry had the ability to engage an audience not only through his scientific knowledge, but also through his incomparable capacity to understand and synthesize complex theory, his culture ‘generale,’ and his always a propos humor. This ability to engage extended to his colleagues’ wives and children. For many of his European colleagues’ young children he was considered the beloved ‘Uncle from America,’ a status which he loved and

richly deserved. He could play both Saint Nicolas and Santa Claus to the delight of children and their parents.

He attained his beloved status with adults the same way he did with children: through the simple trick of paying genuine attention to those he cared for. All of us can recall annual phone calls celebrating our birthday and other events. He would try to understand our problems, inquire about our backgrounds, our studies, our hopes, and our dreams because he was truly interested in us. He would inevitably offer advice, some helpful, some not, but all of it heartfelt. One of the most famous words of advice was “do not do anything I wouldn’t do” which was either helpful or dangerous depending on the interpretation.

Larry did have enemies, but in his mind he thought that even his worst scientific adversaries were potential friends. He neither felt nor showed aversion to competing colleagues. Unfortunately not all of his competitors felt the same about Larry sometimes because his driving personality led to misunderstandings about his character or intentions. Yet, we were continually astonished when Larry would invite a visitor to his house who was well known to be a strong and vocal detractor of Larry’s work. This individual would receive the same hospitality as a close friend, for Larry could easily forgive, or simply ignore, past grievances.

Larry had a large, picturesque home in the Berkeley hills that he made available to colleagues, friends, friends of friends, and just about everyone else. All of us have been guests in his home, and know the kindness, warmth, and generosity of their host. A favorite guestroom was the “Honeymoon Suite,” a small airy room off the main house giving views on all sides of tall California eucalyptus surrounded by heavy fog in the early morning quiet of the Berkeley Hills. His breakfast nook was the site of many spirited conversations between Larry and a frequent houseful of guests.

Larry’s home in the Berkeley Hills was also a site of frequent, memorable wine and cheese parties where he welcomed students, friends, family, and colleagues on an almost continual basis. It felt like our home too—perhaps because we all had the combination to his front door lock! These events were always special and not to be missed. Sometimes the party honored a visiting scholar or friend, or the publishing of a paper, or a scientific concept. Many times Larry’s imagination formed



Photo 1. Larry Stark samples some fine French wine with one of the authors (Gabriel Gauthier).

the theme of the party; for example, the Herring Party—where we had varieties of herring in honor of Ewald Herring, a 19th century physiologist active in vision research, or the Wiener Kernel Party that featured quiches consisting of sliced hot dogs (wieners) and corn (kernels). Larry had worked with Wiener kernels in an effort to characterize nonlinearities in biological systems. But most of the time Larry's gatherings were just that—gatherings of friends and students and colleagues all enjoying each other's company and Larry's warm hospitality. These events created a bond among generations of his students that few of us have replicated or enjoyed elsewhere. They also helped develop the personal side of our relationship to Larry.

Larry was continually curious and had a constant thirst to learn, but he was an unorthodox teacher, who rarely gave formal presentations. Doug Hansmann recalls being a bit disappointed when he took his first graduate seminar with Larry as the professor. Instead of a series lectures by the famous Prof. Stark, the seminar was structured as a discussion among graduate students with each of the graduate students taking a turn leading the group. A recent published article was usually the topic of the day. He initially resented that Larry was not even leading the discussion. It seemed like just an easy way to teach a class. But he soon realized that this was Larry's way of showing his students how to explore new areas and challenge new ideas: both the published ones and their own. Never passive during the meetings, he would stimulate discussion, provide counter examples, and challenge his students to see what new ideas the discussion produced. The power of intelligent, provocative minds working together was a lesson that Doug and the rest of us have carried to this day. Throughout it all, you could see Larry's sparkling eyes relishing the fun of learning from his students as much as he was teaching them.

As with his lectures, his dress code was Berkeley informal, even at occasions calling for otherwise. In his Berkeley period he only had one tie: a 'string tie' that he picked up in Phoenix. But once, in 1969, when he was inducted as a Fellow of the IEEE, he actually wore a tuxedo to the awards dinner. After the dinner he drove out to Newark airport to meet his graduate student, John Semmlow, who had flown out from Berkeley to give his first ever conference presentation in Princeton. Larry met the bedraggled student at the gate (you could do that in those days) and quickly grabbed his suitcase and insisted on carrying it through the busy airport. It is not often that a grubby Berkeley graduate student gets to follow behind a tuxedo-clad porter who also happens to be his thesis advisor.

Larry's playfulness was evident in his everyday experiences where he tempered his strong personality and firm opinions with pragmatic flexibility. Larry and daughter Elizabeth joined his graduate student Bob Kenyon and his wife Cindy in their cozy apartment on Green Street in San Francisco along with another of Larry's students, Terry Bahill and his wife. Now it was somewhat intimidating to invite Larry to dinner: he was very vocal about eating right and that milk products were bad for your system and should be avoided. (Bob recalls that he used to make milk by taking a packet of non-fat dry milk and dump it in a container of water and carefully mix it up...a procedure that struck Bob as akin to military maneuvers!) Larry and his somewhat anxious graduate students survived the main course and were on to dessert: a home made chocolate swirl cheesecake right from the pages of *Bon Appetite*. Larry looked at dessert and said firmly "oh, I don't eat cheesecake." So, Bob and Cindy served the other guests, then themselves and offered Larry some fruit. After some time Larry sheepishly said "well, maybe I'll have a very small slice." That small slice soon led to Larry taking the rest of the cake home with him. The lesson? There is always room for prudent compromise.

Larry's flexibility extended to his expectations for himself, for others, and for the circumstances of life in general. In 1979 after the School of Optometry had finished building its then new building and Dean Enoch planned to have the entire faculty vacate Minor Hall and take up residence in the new building. Larry really did not want to leave; he had a great space in the older building. Bob Kenyon was sitting on the couch in Larry's office when he returned from his meeting with the Dean to discuss this move. (Larry often pointed out that of all the professors only he was authorized to have a couch in his office since he was a psychiatrist by training and degree.) He told me that he and the Dean agreed that he could stay in the same location "but that it would only be temporary." He then returned to sorting papers and a few seconds later he looked up at me and grinned his wily grin saying "you know... life is temporary." He then laughed mutedly almost laughing and not laughing at the same time because he knew it was true. Some 30 years later Larry was still in the same offices enjoying his space in Minor Hall. His lesson on "temporary" helped Bob put into perspective many of life's detours. Larry's teaching was masterful even when unexpected.

Following close behind his passion for people were his enthusiasms in areas of nature, science, and the arts. In science,



Photo 2. Larry Stark engaged in biomedical analysis using an early computer. A rare photo that shows Larry in jacket and tie. His then graduate student, Larry Young, is second from the right.

Larry combined a keen intellect with a strong intuition and clever ways of looking at biological phenomena. Larry Young, Larry Stark's first graduate student, recalls his first encounter with Larry Stark back in 1959, Photo 2. "The two of us hit it off at once. He was young, optimistic, funny, and filled with enthusiasm about what control theory could bring to physiology." Larry (the younger) had had some experience in classical control theory and was "entranced by the elegance" of Larry's pupil model. He was struck not only by the correctness of the analysis, but the cleverness of experimentally "opening the loop" of the pupil response to light by concentrating all of the illumination in a small spot in the center of the pupil. Larry used a similar technique to artificially increase the gain of the pupil system by focusing the light into a small spot on the edge of the pupil, so that even a small constriction or dilation would result in a large change in light reaching the retina. Not only did the pupil then oscillate, but it did so at just the frequency Larry had predicted from the Nyquist diagram he had learned to construct from Prof. Schultheiss at Yale. At this Larry, the younger, was hooked (as were so many of us who came after him) and he wanted to do his doctoral research under Larry.

Some of Larry's colorful personality is likely attributable to his early scientific environment. In those times, scientific genius came in personalities ranging from colorful to bizarre. Larry Young describes the atmosphere in what is now called biolog-

ical control systems around Larry Stark's laboratory at MIT in the late fifties and early sixties. In general, science was still filled with a kind of unbounded optimism that grew out of the wartime advances. Nuclear energy was not yet dirty, physics was marching along toward a few fundamental particles and a theory to unify all forces, and in biology the double helix had just appeared. Around MIT, Norbert Wiener, the great mathematical genius, had spread his ideas on optimal estimator theory to practical applications in medicine. He spoke of Parkinsonism as a feedback control problem and, when he was laid up in Mass. General Hospital he got orthopedic surgeon Mel Glimsher and MIT mechanical engineer Bob Mann interested in the "thought controlled" Boston Arm. Claude Shannon, of Information Theory fame joined the faculty and tried to interest students in biomedical applications. The Macy Foundation had sponsored a workshop to see what mathematics and engineering could contribute to biology and medicine, and attracted a large following from Boston. Jerry Wiesner was MIT's Provost, in his days before becoming Kennedy's Science Advisor and MIT president, and he apparently recruited Larry to Cambridge. Jerome Lettvin had published his remarkable paper on what the frog's eye tells the frog's brain, showing the importance of peripheral neural processing. Warren McCulloch, psychiatrist, mathematician and genius, Walter Pitts, mathematical genius and recluse, and Pat Wall, motor systems and pain



Photo 3. Larry Stark (left) with two of the authors (Semmlow center and Hansmann right) after climbing and surviving Mount Shasta in northern California (circa 1970).

neurophysiologists, all were part of Larry's MIT intellectual coterie. As with Larry's own students, it would have been difficult to escape the outlandish influence of the likes of Lettvin and McCulloch (who wrote the forward to his 1968 book on neurological control mechanisms).

Shiro Usui notes the large number of Japanese students that Larry has mentored, including himself. As Larry's student, he too was impressed with Larry's ability to transfer his boundless enthusiasm for science to his students. He was continually encouraged to imagine innovative experiments that others would "consider crazy," but just might "make him famous." Shiro has documented many of Larry's scientific achievements and published them in the online journal *Scientiae Mathematicae Japonicae* (On Lawrence Stark and Biomedical Engineering: pp. 505–507, vol. 64, no. 2, 2006).

While less known, Larry's passion for nature and the arts were no less strong than those for science. Larry loved the outdoors, taking students, colleagues, and guests alike on impromptu hikes around his Berkeley home or birding expeditions. He particularly enjoyed the mountains in California and often took his graduate students on hiking or backpacking trips into this wonderful wilderness.

On one such trip, Larry made a summer ascent of snow-covered Mt. Shasta in Northern California, with two of the authors, then his graduate students, Doug Hansmann and John Semmlow (Photo 3). The two day ascent required an overnight bivouac at a mountain feature called 'Lake Helen,' at the half-

way point of the ascent. Far from being a water feature, Lake Helen was a small rocky ledge protruding from the vast, steep snowfield in a south facing portion of the mountain called, ominously, 'Avalanche Gulch'. As if confirming the name, there were frequent sporadic rumbles of falling rock and snow. Local knowledge claimed the 'lake' to be a safe haven. Having made camp and downing a quick meal, John had fallen asleep, but Doug and Larry sat up in their sleeping bags watching the spectacular starry night with the moon lighting the mountain above them. Suddenly, the tremendous roar of an avalanche enveloped them from directly above. Doug recalls seeing the terror in Larry's eyes as they both realized this might be their last moments alive. A few seconds later they caught the image of a jet aircraft as it flew overhead. That was the source of the roar—not a deadly wall of snow. Larry's face immediately changed to the image of salvation, and then relief, and then his famous laugh echoed across the gulch as we both celebrated living to climb another day. Larry taught us to love life every day (Photo 4).

Larry's passion for art complimented and enhanced his long-standing interest in vision and the visual system. Larry grew up in Manhattan and his early exposure to art undoubtedly came via the magnificent museums found on that island. While he never lost his enthusiasm for museums (a trip to New York always included the Metropolitan Museum of Art at minimum), he became particularly interested in, and supportive of, local artists and local art events. Larry found art openings particularly



Photo 4. Larry Stark at the top of Mount Shasta in northern California. He had just escaped a ‘virtual avalanche.’

exciting as they combined his love of people with his love of art. A guest of Larry’s would as likely be invited to a local art opening as a hike up to the top of Volmer Peak in nearby Tilden Park. He strongly encouraged the artistic side of his three daughters, two of whom are now writers (Elizabeth and Nanu) and the third a painter (Stephanie). The walls of his home were covered by works of local artists, his daughter’s art, and later, some of his own pieces.

Larry had great difficulty being a passive observer so, as with many other interests, he had to do art as well as enjoy it. Larry’s foray into creating art was like all his efforts filled with energy and enthusiasm. Larry’s art works were those of a true amateur; he painted (or made prints) for the sheer joy it gave him. His works range from futuristic pastels to abstract monotypes. He was particularly excited by the monotype process (in which inks are first applied to a stone then transferred to paper) because of its immediacy and its spontaneity, but mostly because of its surprises.

Perhaps because it encompasses both science and art, Larry had a long-standing interest in the concepts of information processing, a theme that comes up throughout his scientific and other writing. His interest was aroused serendipitously, when it turned out that his MIT office was immediately next to that of Claude Shannon’s. Larry once related that he always kept his MIT office door open in the hope that a few stray “bits” would wander in from Shannon next door. Once, when he and Shannon were walking across Harvard Square, Shannon spotted a newly opened store that made xerox copies, one of the first

such copy stores in the country. The sign above the store read “Get your copies here. The copies are *better* than the original;” to which Shannon remarked, “There goes my life’s work down the drain!” Of course, Shannon’s theories have withstood Xerox advertising, and a copy cannot contain as much information as the original.

Regrettably there will never be even a copy of the extraordinary individual that was Larry Stark. Yet, as Bob Kenyon puts it: his memory lives on in our minds and our heart, particularly the memory of his laughter. Bob could always figure out where he was in a big reception hall by listening for that distinctive laugh. Larry loved living and certainly lived as full a life as one can imagine. He shared his joy and love of life with all those around him. So, as his science lives on in his works, his unique enthusiasms, passions, and wit lives in all of those he touched: we still hear his laughter.

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