

A Life Unplanned

Lawrence Crum



When Art Popper called me and asked if I could write a 1,500-word article on serendipity, I said “Are you kidding me, my life has been an experience in Serendipity—I can write a book!” I don’t want a book, he said, and not about your life but about

how it influenced your career in acoustics. With some reflection, I found several events in my life that greatly influenced what I wanted to do. These serendipitous events were instrumental in what I did as a career and who I am as an individual.

I did most of my undergraduate studies at the United States Naval Academy in Annapolis, Maryland. Unfortunately, after three years there, for personal reasons, I had to resign. At the Naval Academy, at that time, there were no majors or advanced degrees. We were training to become warriors and so we were given a broad education that prepared us for a career in the military.

However, for those of us who had good grades, we were allowed to take an “overload,” that is, any course being taught at the Academy in addition to our regular course load that already was on the order of 20 (or more) semester credit hours. Of course, because there were no majors, the only way we could take an overload was to arrange something with an individual faculty member. I was a good student, especially in my history class, so I asked my history professor if he would teach me an extra class. He said he was a specialist in Russian history, and so I took a course from him in that field. I was so interested in that course and did so well that he suggested I take TWO overload classes. He said that he was the Academy’s advisor for the Fulbright program, and if I did as he suggested, I could probably win a Fulbright fellowship after graduation, so I took several (tutorial) courses from him.

After three years, I transferred to Ohio University, Athens, which was near home. But as a result of my three years at the Naval Academy, I had enough course hours to

graduate from Ohio University once enrolled. (By the way, I actually earned a Fulbright, but later on as a Faculty Fellow.) However, when my Ohio University advisor saw my transcript, he said that it would probably take me at least two years to fulfill the requirements for a major in history. Perplexed, I asked him if there was a field for which I could get a degree in the minimum amount of time. He saw that I had several courses in mathematics, and if I took 16 semester hours of math that summer, I could get a BA in mathematics. So, I did and graduated at the end of the summer; then I looked for a job. However, no one wanted to hire me with a math BA, and I couldn’t teach, as I didn’t have the education requirements. Quite dismayed, I went by the Physics Department and asked the department chair if I could take a few physics courses to improve my hire ability. Remarkably for me, he said that with a math degree I could go directly to graduate school in physics and that he would give me a teaching fellowship that not only paid my tuition but also covered living expenses as well. Serendipity: that’s why I’m a scientist rather than a historian.

It was difficult to learn graduate level physics with only one undergraduate course, but soon I caught up and then it was time to find a theses advisor. Again, with “Time being of the essence.” I was married and already had one child and another on the way. At the end of my second year, I went to each faculty member and asked which of them could ensure that I could graduate within another

More about this author

 READ

“Meet Past President of ASA,
Dr. Lawrence Crum”

bit.ly/3AgyE3I

A LIFE UNPLANNED

two years. In those days, nuclear physics was hot (remember Oppenheimer) so I wanted to work in nuclear physics, but I would have to wait at least two years to start my research. Frustrated, I talked with Physics Professor Burt Stumpf, who had no students, probably because he was working in the engineering field of acoustics. Happily, Burt told me that he had just received a new three-year Office of Naval Research grant to study the interaction between sonar transducers and I could start tomorrow. Serendipity: that's why I'm an acoustician.

Burt Stumpf was one of the finest university members that I have ever met. He took a personal interest not only in my education but also in my life. He was not a well-known scholar, although he was an Acoustical Society of America (ASA) Fellow. He was a devoted member of the ASA and insisted that I become a member of ASA as soon as I was his graduate student (that was in 1965, so soon I will be celebrating my 60th anniversary with the ASA). Burt made me go to every ASA meeting; his grant reimbursed me for my expenses, and he strongly recommended that at the meetings of the ASA, I present a paper on my ongoing research.

I found the ASA a remarkably welcoming place and gained many friends and associations as a graduate student. With Burt's expert guidance, I defended my dissertation after two years and started looking for a postdoc. Burt said that I should work with someone with a strong reputation in acoustics and gave me the names of those who were eminent at that time. Furthermore, during my fourth year in graduate school, Burt made me give a short briefing on each of the major physical acousticians of the day and what their specialties were. Thus, when I started looking for a postdoc advisor, I knew all those who were the major players in physical acoustics in the United States. So I wrote letters to nearly all of those well-known professors, and I had replies from nearly every one of them, maybe because they saw me at ASA meetings and even attended my papers. Serendipity: Ted Hunt at Harvard University, Cambridge, Massachusetts, one of the most respected acousticians in the United States invited me into his laboratory, and consequently, I was immediately accepted as one of his "students," an honor that helped me gain recognition in the ASA.

At the Naval Academy, every midshipman had to be involved in a sport. Since I really liked soccer, I tried out

for the plebe (freshman) team, and at the end of the year, the soccer coach told me that I had made the plebe team, but I would play only sparingly. Another requirement for midshipman was to learn something about every one of the 24 NCAA sports at the Academy. Fortunately for me, when I met the fencing coach, he convinced me that I could not only be on the plebe team, but I could participate in nearly every match. There wasn't a lot of interest in fencing at the Academy. Serendipity: not only did I make the varsity team, but I won the NCAA National Championship in three years and was a member of the 1964 Olympic Squad, but not the team, which meant that I could not go to the Olympics as a competitor. However, it also directed me to my first real job.

After I finished my postdoc at Harvard in 1968, I started looking for a position as a faculty member at a university. There were a few good offers, but I still dreamed of making the Olympics and so I accepted a position on the physics faculty of the Naval Academy. This was a great job. I taught motivated students sophomore physics twice a week and spent lots of time playing golf, working out with the fencing team, and having a position (unpaid) as assistant fencing coach. Unfortunately, there were too many responsibilities as a new faculty member and by the demands of my family, so I never made any real effort to try out for the team.

A few years after I joined the faculty at the Naval Academy, the Office of Naval Research (ONR) announced that one member of the Academy would be awarded a large grant and become an ONR Research Professor for a year. Fortunately, I won the competition and had a full year with no teaching responsibilities and could concentrate on my research. I was interested in acoustic cavitation, and with my grant money, I organized a symposium on the topic. Among the attendees was a renowned cavitation expert, Terry Coakley of the University of Wales in Cardiff. We hit it off so well, he invited me to visit him and collaborate on cavitation research in tissue. I was due for a sabbatical, so in 1987, I took my family to live in the United Kingdom for a year. What a year that was! With no demands on my time, we bought a Volkswagen camper and put over 20,000 miles on it driving through all of the United Kingdom and Europe. And I was able to do enough research to write 11 journal articles on various topics that year. That serendipitous event greatly affected my entire life as I focused my research on international

collaborations and was lucky enough to spend much of my career traveling around the world to organize meetings and collaborate with colleagues. Indeed, one of my most notable achievements was to make lifetime Diamond status on the Delta Airlines frequent flyer program, accumulating nearly 4 million miles.

In 1988, having proved to myself that I could do research, I went to the University of Mississippi (Ole Miss) in Oxford, Mississippi. While there, physics faculty member and acoustician Hank Bass, a few others, and I formed what we called PARGUM, Physical Acoustics Research Group at the University of Mississippi. Now Ole Miss is mostly a football school and not known for its academics. Consequently, PARGUM stood out as a strong research group and attracted the attention of the chancellor (president). Furthermore, at that time, the head of the United States House of Representatives Appropriations Committee was our local representative to the United States Congress, Jamie Whitten. In addition, the head of the United States Senate Appropriations Committee was Mississippi's Senior Senator, John Stennis, and in those days, "earmarking" was considered good for the country. Serendipity: the chancellor convinced the Mississippi federal representatives to earmark (appropriate in the United States) a budget of approximately \$20 million to create the National Center for Physical Acoustics (NCPA), and I eventually became its director.

While at Ole Miss, I collaborated with a brilliant colleague from Johns Hopkins University, Baltimore, Maryland, Andrea Prosperetti, who had written a highly cited article suggesting that the underwater noise produced by precipitation was a major component of the ambient noise in the ocean. One of my graduate students, Hugh Pumphrey, had discovered that raindrops generated an underwater bubble on impact and this bubble generated a significant component to ocean ambient noise in the kilohertz-frequency range. Andrea wondered if snowfall generated any significant noise and suggested we do some experiments. Of course, there is seldom snow in Mississippi; however, while visiting Bob Apfel at University, New Haven, Connecticut, a big snowstorm was predicted for the Washington, DC, area. Borrowing Bob's car and a couple of his graduate students, we loaded up his car with instruments and we went storm chasing. We caught up with the storm in Northern Virginia and convinced a Holiday Inn motel manager to let us use his

swimming pool. While surrounded by hotel guests as we instrumented the pool, we obtained some very interesting data on the amazingly loud sounds produced by impacting snowflakes (Crum et al., 1999). In that experiment, performed in a motel swimming pool during a heavy snowstorm, we discovered that the ambient noise in the pool increased by over 30 dB in the hundreds of the kilohertz-frequency range. Our paper on the subject generated such general interest that Kenneth Chang wrote a full-page story on it in the *New York Times Science Times* and I was interviewed by Scott Simon on NPR. Serendipity: I was famous for 15 minutes.

After a few years as director of NCPA, I became interested in technology transfer and found the investment community in Mississippi lacking. Accordingly, in 1992, I accepted a job in the Applied Physics Laboratory (APL) at the University of Washington. Seattle was and is a hot spot for startups, and I wanted to try my hand at founding some companies. While at the APL, I consulted for a small startup in Silicon Valley, California. When I was shown its technology, I became terribly interested in the area of medical acoustics. I saw a man being treated for BPH (benign prostatic hypertrophy). A device was inserted into the patient's rectum and this device imaged the prostate and then applied high-intensity focused ultrasound (HIFU) to denature the tissue around the urethra. When they applied the HIFU, there was a popping sound that I eventually described in a subsequent research paper as HIFU-induced "popcorn" (Crum, 1996). The ultrasound was applied at such an intensity that the tissue was superheated, and then when a nucleation site was initiated, the tissue exploded into a vapor bubble. This phenomenon, heating tissue until a vapor cavity is formed, which subsequently results in major disruption and lethal damage to the tissue, is now a major technology: Boiling Histotripsy. Serendipity: seeing HIFU-induced popcorn appearing in a human induced me to develop my principal area of research, therapeutic ultrasound.

For most of my career, I have been a researcher in acoustics, generating research proposals to whomever would accept them, and when funded, I made plans as far in advance as five years as to what we would discover. It hardly ever turned out that way. Many of the most important discoveries were unintended. Indeed, my life has been a lot like my research projects, planned, but as

A LIFE UNPLANNED

described above, few things went as I had hoped, but then serendipity happens, and things tend to work out for the best.

One of my favorite poets is Robert Burns (1786), who wrote:

“The best laid schemes o’ Mice an’ Men
Gang aft agley”

So, Art, you are right. Serendipity rules!

References

- Burns, R. (1786). To a Mouse. In R. Burns, *Poems, Chiefly in the Scottish Dialect* (pp. 138-140). John Wilson, Kilmarnock.
- Crum, L. A. (1996). “Popcorn” — and the role of acoustic cavitation in HIFU surgery. *The Journal of the Acoustical Society of America* 99, 2511-2529.
- Crum, L. A., Pumphrey, H. C., Roy, R. A., and Prosperetti, A. (1999). The underwater sounds produced by impacting snowflakes. *The Journal of the Acoustical Society of America* 106, 1765-1770.

Contact Information

Lawrence Crum

lacuw@uw.edu

Center for Industrial and Medical Ultrasound
Applied Physics Laboratory
University of Washington
1013 NE 40th Street
Seattle, Washington 98105, USA

PARTICIPATE IN
DEVELOPING AND VOTING ON
ASA STANDARDS PROJECTS



**Become an Organizational
Standards Member!**

www.ASAstandards.org

Previous Issue

.....

Fall 2017


Image: Graphic copyright ©2017 Mark B. Weinberg, Potomac, MD. All rights reserved. More of the artist's work can be seen at edgieart.squarespace.com

Visit bit.ly/AT-Fall-2017

Volume 13 | Issue 3 Fall 2017

Acoustics Today

A Publication of the Acoustical Society of America



Animal Psychoacoustics

Also In This Issue

- The Acoustics of Marine Sediments
- Improving Academic Mentoring Relationships and Environments
- Imaging the Listening Brain
- Chacoustic Bivalves: Can Laboratory Research Improve Their Clinical Utility?