My Career in Mathematical Biology
A Personal Journey

John Milton

Baby Boomer to Biomathematician

In 1967, at age 17, I arrived at McGill University to face introductory classes that bulged with thousands of Boomers students--classes that were many orders of magnitude larger than my entire home town of Port Williams, Nova Scotia. No matter about the cramped quarters, for us enthusiastic Baby Boomers, it was an exciting time to be in Montreal. The town blossomed during Expo '67, and McGill was still the magnet that attracted the best students from Canada and the British Commonwealth.

It is said that universities tear down the dreams of boys and then rebuild them as the careers of men. With my high school dream of a marine biology career washed away because of my inability to swim, I found myself enrolled in a Cell and Molecular program in the Department of Botany under the supervision of Ronald Poole and Gordon A. Maclachlan. Brian C. Goodwin (Temporal Organization of Cells) had studied in this department a few years prior, and I was intrigued that someone had actually been able to develop mathematical descriptions of biological systems. McGill already had a long history of biologists studying mathematics, and thus I was able to include lots of math courses in my honors program — the most influential being courses in probability theory and qualitative theory of differential equations.

In 1971, choosing a graduate school was problematic since there were no mathematical biology programs of the type that are widespread today. By chance I met William C. Galley, a biophysical chemist at McGill, who excelled in my two scientific loves, thermodynamics and simple mathematical models that described experimental observations. Thus, I found myself developing excited state spectroscopic techniques to study the movements of solvent molecules on the surface of macromolecules, such as DNA.

It was during this time that I read Robert Rosen's *Dynamical System Theory in Biology* as part of my qualifying examination on periodic chemical reactions and their role in biology. On completing my PhD in physical chemistry, I was awarded a Japan Society for the Promotion of Science award to work on oxygenases in the laboratory of Osamu Hayaishi at Kyoto University. I was pretty miserable scraping rabbit intestine to purify these enzymes, and hence Professor Hayaishi suggested that I look around campus and see if I could locate another suitable lab. Armed with only a Japanese-English dictionary, I eventually discovered the laboratory of two pioneer Japanese bio-mathematicians, Ei Teramoto and Nanako Shigesada. To my amazement, their laboratory had just completed translating Rosen's book into Japanese!

I had a wonderful time in Kyoto studying mathematical ecology. However, it was in Japan that I began to understand the downside of the "baby boomer" generation—there were no jobs in academia. In their efforts to cope with high student numbers, universities had greatly increased the size of their faculties. All these new young faculty members effectively eliminated job opportunities for the next generation of graduates, especially in new fields such as mathematical biology.

My rallying cry became that old adage "any port in a storm". Fortunately, S. G. Mason, a rheologist, had a position available for a post-doc in the Pulp and Paper Institute at McGill University — and you guessed it, I was back to McGill after a two year absence. Professor Mason quickly recognized that I was much more interested in biology than pulp wood and suggested that I work on blood platelets in

the lab of his colleague, Mony M. Frojmovic, in the Department of Physiology.

The next 13 years in the Department of Physiology was a great stroke of luck and changed my life in unforeseen ways. First, I met two young professors, Michael C. Mackey and Leon Glass, who were just beginning their collaboration that led to the now famous Mackey-Glass equations. One day I suggested to Mike that there were lots of interesting problems in hematology, and this started a friendship and collaboration that has lasted over thirty years. Second, the Canadian Heart Foundation launched a program to send PhDs back to medical school. I was fortunate to be awarded one of these fellowships and in 1978 began life as a McGill medical student. I then completed a neurology residency and fellowship in epilepsy at the Montreal Neurological Institute. During this time I met a young physics student, Andre Longtin. Together with Mike Mackey, we studied the pupil light reflex — an investigation that was helped by my experience with cinematographic techniques created while studying platelet shape change and by the support of the Hamamatsu Corporation who loaned us a pupillometer.

In 1989, it was time to finally leave McGill. I was recruited to the Department of Neurology at The University of Chicago by Barry G. W. Arnason. There I ran the clinical epilepsy program with my good friends Jean-Paul Spire and V Leo Towle and conducted basic research in computational neuroscience. At the U of C, my research focused on whether it might be possible to develop feedback control devices to treat neurological diseases such as epilepsy. Although I didn't get far on this project, thanks to great graduate students (Jennifer Foss and John D. Hunter), wonderful post-doctoral fellows (Juan Luis Cabrera and Christian D. Eurich), and shared students with Jack D Cowan (Toru Ohira and Trevor Mundel), I was able to greatly expand my research on the dynamics of neural populations including the formation of travelling waves, multistability, and spike timing reliability.

Perhaps not surprisingly, the expressive baby boomer generation had still more to say about my career. Many of my baby boomer patients with chronic neurological disease sorely missed playing golf. The deceptively simple research question was, "Could rehabilitation strategies be improved by making them more fun?" To answer it, I approached the Ladies Professional Golf Association (LPGA) and with the help of Betsy Clark, research director, and Rosey Bartlett, golf professional and 2005 national teacher of the year, was able to complete golf professionals' instructional programs with an emphasis on teaching disabled golfers. This, in turn, led to the creation of a short-lived golf neurology clinic-- an idea that was picked up nearly ten years later by the American Heart/American Stroke Associations in their "Saving Strokes" programs. Even more important, I was intrigued to discover that the LPGA emphasized educational science not simply teaching golf skill. This led me to ask how the nervous system learns a skill and becomes expert in its performance. These questions have formed the basis of my mathematical and experimental research for the last 10 years.

In 2003, Mike Mackey drew my attention to a sabbatical position advertised by Dr. Lisette de Pillis at Harvey Mudd College in southern California. At Mudd, I soon found myself teaching a course on the mathematics of toys and play. One thing led to another, and I became the William R. Kenan, Jr Chair in Computational Neuroscience for all five Claremont Colleges.

In this liberal arts college environment, I find it very rewarding to work with undergraduates and help them appreciate the value of mathematics in biological research. Not only has my students' enthusiasm kept me young, but by teaching them, I have the opportunity to repay the kindness and understanding I received from the many mentors that shaped my Baby Boomer's career.

Students today are dismayed by the effects of the global economic downturn on their future. However, the "booms and busts" of society have always affected the dreams of its youth. Here's my advice: My career happened not by conscious design, but through chance encounters and coincidences shaped by demographic forces. It was true that I was lucky enough to meet key mentors along the way, but more importantly I never turned down an opportunity, always did the best I could, and above all, I had fun!

Selected Publications:

John Milton's publications can be obtained from the website http://faculty.jsd.claremont.edu/jmilton/.