

Patricia Foster

Patricia (Pat) Foster, known internationally for her groundbreaking work on the mechanisms that increase mutations in bacteria under stress, retired from the Department of Biology in December 2016 after an academic career of 32 years, including the past 17 at Indiana University. Pat grew up in a small town of Northern California where she loved exploring nature. She was particularly fond of salamanders, and later learned in a seminar by an IU colleague that the species she so loved to observe, and sometimes handle, is poisonous. She attributes her attraction for science to her childhood curiosity for nature and to her father, a chemical engineer, who loved to share his daily problem-solving experiences at the dinner table. As a high school junior, she participated in an eye-opening, NSF-sponsored program at UC Davis where she conducted research for six weeks. The experiments did not work, but she was hooked.

Pat's attraction to microbiology began during her undergraduate days as she learned about bacteria in a Cell Biology course. This attraction was cemented at the University of Chicago when she heard a seminar by then IU Bacteriology Professor Thomas Brock about environmental microbiology. With her B.S. in Microbiology from Chicago (1968) and an M.A. in Environmental Microbiology from Harvard (1970) in hand, she worked for four years as an environmental microbiologist for an engineering firm, studying the effects of pollution in the Charles River and Boston Harbor. She pursued her interest in environmental microbiology during her studies at Cambridge University (Ph.D., 1979) where she studied metal toxicity. Her first paper was a sole-author work published in *Nature*, a study of heavy metal tolerance in algae. Noticing that what seemed like isolates of the same species of algae could have different levels of metal tolerance, Pat realized that she needed an experimental system with amenable genetics to pursue mechanistic studies of adaptation to environmental stress.

An Interdisciplinary Postdoctoral Fellowship at the Harvard School of Public Health (HSPH) allowed Pat to pursue research on any topic of her choosing. She joined the laboratory of Eric Eisenstadt to study the genetics of mutagenesis in *E. coli*, publishing a key paper from that period, once again, in *Nature*. This elegant study of the distribution of mutations across a single gene using classical genetics methods presaged her current studies of the distribution of mutations in the entire *E. coli* genome (4,377 genes), conducted with modern genome sequencing methods and large data visualization algorithms developed by her husband Andrew (Andy) Hanson, IU Professor Emeritus of Computer Science. Next door neighbor to Eisenstadt's laboratory during Pat's postdoctoral days at HSPH was John Cairns, who would become an important long-term collaborator. At the time, Cairns was working on what became a famously controversial paper about the possibility that a population of bacteria under selection had a mechanism to direct mutagenic change to the very genes that would relieve the selective pressure. He asked Pat to comment on the manuscript, which she did in a text of 15 pages! Within six months, Pat and Cairns wrote a successful grant proposal to study the mechanism of this so-called "directed mutagenesis" (later called "adaptive" and now "stress-induced" mutagenesis). What followed, first at Boston University (1987-99) and then at Indiana University (1999-present), was an impressive number of important studies on the mechanism of stress-induced mutations. Some of these studies were conducted with Cairns, but most were conducted solely by Pat and her students, and have made her a leader in the study of

mutagenesis. This work earned her a prestigious NSF Grant Extension for Special Creativity. Among many other awards, Pat was elected to fellowship in the American Academy of Microbiology and the American Association for the Advancement of Science.

Since 2010, Pat has shifted most of her focus to a study of the constraints on mutation in bacteria using high throughput genome sequencing methods, made possible by a \$7 million grant from the Army Research Office (ARO), which she led, and a second \$6 million AOR grant she co-leads with IU Professor Michael Lynch. The first grant might never have happened, because Pat was ignoring the many emails from a, thankfully insistent, ARO Program Officer; at first reading it seemed that the call for proposals was suspiciously tailor-made for a different well-known research group, but this turned out not to be the case and the ARO funded Pat's proposal. This large multidisciplinary effort mostly conducted at IU has led to the most comprehensive picture to date of an organism's DNA mutation process, has illuminated our understanding of the patterns of evolutionary change driven by selection, and has important implications for understanding the acquisition of antibiotic resistance mutations by bacteria. Pat has also been a generous colleague and has served on many Biology Department and university committees, task forces, and faculty councils. She served as director of a large NIH training grant for several years, taught the graduate course in Research Ethics her entire time at IU, and most notably served as Associate Vice Provost for Research in the Sciences for three years (2013-15). In this position, Pat developed several innovative programs for catalyzing research at IU that still provide important resources for faculty. Pat has made a lasting mark on this institution as a scientist, a mentor of many students, a colleague and an administrator. We all have benefitted from her efforts and we remain very much in Pat's debt.

With greater time to return to the bench to play with complex problems using her genetic ingenuity, we can expect more striking discoveries from Pat. She also plans to write about science for the lay public, spend more time in her beloved Cambridge, UK, and in Santa Fe and Pasadena, and travel around the world. These trips are certain to include many meals in top gastronomic restaurants, for which Pat and Andy have a well-developed interest. We certainly hope to continue to accompany them in as many of these gustatory adventures as possible.

Yves Brun and Julie Auger
(edited by Clay Fuqua)