Retirement Biosketch for Elizabeth Raff

Professor Elizabeth (Beth) Raff has retired from the Department of Biology in 2019 after a career spanning 47 years at Indiana University. A world-renowned scientist, with expertise in multiple disciplines, Beth pioneered the use of genetics to investigate the roles of individual tubulin genes in the function of microtubule polymers. Beth played a formative role in the nascent field of Evolutionary Developmental Biology (EvoDevo), performing experiments that would show how the same cellular polymers could be refactored to allow for new functions throughout animal development. A tireless mentor, teacher, and advocate for science, Beth taught core undergraduate and graduate courses to hundreds of students over her career while running her research laboratory and serving on critical Department and University committees.

Beth studied Biochemistry at Pennsylvania State University, obtaining a B.S. degree before moving directly to her Ph.D. at Duke University in North Carolina. As a graduate student with Joseph Blum, Beth developed an experimental approach for deconstructing cilia and working with the motile components, including the microtubules. The work would cement a lifelong interest in how these essential intracellular polymers organize and drive motile cells. Another lifelong interest discovered at Duke was Rudy Raff, Beth's husband and scientific collaborator. Married in graduate school, the two found postdoctoral positions first in Washington, D.C. and later in Boston. During this time, Beth published a prescient work looking at the 'wounding' response in cells that were cultured in a petri dish. This assay would resurface years later as a standard tool in cytoskeletal biology and beyond. Working with her husband Rudy at the time, Beth also played an integral role in setting a course toward an integration of biochemistry and molecular genetics with more classical studies of the fossil record and animal evolutionary biology. A perhaps less well-known aspect of Beth's talents is that she is a very fine artist. Striking evidence of this is that she did a majority of the illustrations for Rudy's 1983 book *Embryo's Genes and Evolution*, which represents the founding of the aforementioned field of EvoDevo.

Beth began her work at Indiana University in 1971 as a postdoctoral fellow in what was then the Department of Zoology. Her work with Rudy examining a tubulin mutant in axolotl embryos resulted in a major paper indicating a primal role for microtubules in early development. Seeing the power of genetics to explain fundamental biological phenomena, Beth turned quickly to *Drosophila*, the leading model system for genetic studies. With the shift to *Drosophila*, and the reorganization to a singular Department of Biology, Beth moved to part-time assistant scientist and progressed to senior scientist and then to tenured Professor by the early 1980s. The identification of a *Drosophila* mutant with specific defects in spermatogenesis during this time led to a series of now classic papers, published in *Cell* and the *Proceedings of the National Academy*. Led by postdoctoral fellow, Ken Kemphues (now emeritus at Cornell), Beth and her group discovered that the family of 'tubulin' genes expressing the proteins that polymerize to form microtubules were not interchangeable. Different gene isoforms showed specific genetic and biochemical properties that are only now being molecularly characterized. The arrival of Margaret 'Minx' Fuller (now at Stanford) for a postdoctoral fellowship with Beth brought depth and breadth to the evolving story, showing that the lessons learned in

Drosophila spermatogenesis were also true for tubulin genes expressed in other tissues during cell division and in development. In the years following, Beth became a leading figure in the microtubule field, using a carefully choreographed interplay of genetics and biochemistry to discover the mechanisms by which tubulins had specialized to modify the role of microtubule polymers.

Written into so many of Beth's works are the basic and foundational questions about how complexity could have arisen in the natural world. Throughout her career, Beth never left the journey she began with her husband Rudy to reframe how we view animal development through the critical strictures of evolution. Beginning in 1998, Beth and Rudy initiated their annual trips to Australia, serving as visiting Professors at the School of Biological Sciences at Sydney University. Fossil hunting in the outback and a long-standing curiosity about fossilized materials led Beth to an entirely new area of discovery. In a wonderfully novel set of experiments from a marvelously unique team, Beth showed that fossilization is mediated by microbial biofilms. Capping a long and impressive service career, Beth chaired the Department of Biology from 2002-2007, instituting carefully considered organizational changes and weathering a collapse in federal funding that would alter the research landscape for a decade. Through more than 75 scholarly works and reviews, crossing disciplinary boundaries with delightful irreverence, Beth Raff was elected as a fellow of the American Association for the Advancement of Science in 2013 and, with her husband Rudy, presented with the distinguished Career Award for Outstanding Contributions to Geobiosciences in 2015 from the Geological Society of America.

Sidney L. Shaw