

## Rudolf A. Raff



Rudolf "Rudy" Raff passed away on January 5 of this year at the age of 77. Rudy was one of the founders and shapers of the field of evolutionary developmental biology and the driving force behind the existence of this journal, which he served as editor in chief for 20 years. His impact on the biological sciences through his integration of developmental biology with evolution cannot be overstated and is only matched by his impact as a mentor, colleague, and friend. His legacy will stand as an inspiration to generations of scientists.

Rudy was born in 1941 in Quebec Canada in the city of Shawinigan to the daughter of a local doctor and an Austrian scientist fleeing the Nazi regime. The family soon moved to Pittsburgh in 1949, and Rudy describes in his last book, *Once We All Had Gills: Growing Up Evolutionist in an Evolving World* (2012), that not knowing how close to the equator he was headed, he remembered watching through the window searching for waving palms and coiled rattlesnakes. His disappointment was quickly remedied, however, by his discovery of

the Carnegie Museum collections, especially dinosaurs, and the growing realization that life on earth had gone through many changes, leaving traces of past worlds, recognizable to those who care to look closely.

Rudy left Pittsburgh in 1959 to attend Penn State University, enrolling in the Navy Reserve Officer Training Corps. During this time, Rudy's fascination with all things biological blossomed. Dragonflies, in particular, became an object of close affection. Rudy began graduate school at Duke University in 1963, a move that would bring about foundational changes in his life. Chief among them was meeting his wife, coadventurer, and closest colleague Beth Raff. He completed his PhD in biochemistry in 1967. His research focused on bacterial surface proteins, but in the process Rudy found himself drifting closer towards questions focusing on evolutionary origins and transitions. As a US Navy officer, the likelihood of service in Vietnam was high at this time; instead, Rudy was assigned to the National Naval Medical Center in Bethesda, MD, with surprising freedom to carry out any research, as long as it involved exposing biological materials to radiation. In 1978 Rudy learned that his position, and in fact the entire institute, served as an elaborate cover-up to mask the cold war era neutron bomb development program. Rudy transitioned to a second postdoctoral position in 1969 at the Massachusetts Institute of Technology under Paul Gross, beginning his first deep journey into the nature of developmental biology, and specifically the role of maternally derived messenger RNA in guiding early development of embryos. It also marked Rudy's first use of sea urchins as a study organism, a relationship that shaped the remainder of his career.

Throughout his professional life, Rudy stood as an inspiration to his friends and colleagues across his international network. Central to these efforts were Rudy and Beth's annual visits, for 30 years, to the University of Sydney to conduct their research on *Heliocidaris* sea urchin species. Rudy and Beth made numerous friends in Australia, who looked forward to their annual visit, the scientific endeavors they enabled, but also the collegial hunting for creatures alive and fossilized along the south coast of New South Wales. Rudy's enthusiasm and interests inspired many of his Australian collaborators to explore the diversity and the

evolution of Australia's unique marine fauna, and he grew to become an important mentor to a generation of Australian scientists.

Rudy similarly impacted his academic environment at Indiana University, his home institution. He possessed both the talent and the good fortune to attract excellent scientists to his lab, and through his unselfish leadership created a nurturing and stimulating environment. As a mentor, Rudy was both supportive and patient, always ready and eager to discuss projects, but never overbearing and instead willing to let his students and postdocs pursue directions they thought were most exciting. As such his lab became an effective incubator for encouraging the growth and development of many independent scientific careers. Rudy's influence extended not only to the immediate members of his own lab, but also to students in his various undergraduate and graduate courses at Indiana University, as well as those who he taught at the Marine Biological Laboratory in Woods Hole, MA. For several summers Rudy carried out research and served as an instructor and director for the Embryology Course at the Marine Biological Laboratory in Woods Hole, Massachusetts, inspiring many graduate students and postdocs who attended his courses. Rudy was also a role model in terms of his service to both the scientific community and the general public. For example, Rudy routinely took on the intimidating task of participating in public debates to defend evolutionary theory in the face of creationism and contributed to episodes for Indiana Public Media's "A Moment in Science", among many other endeavors.

Through his life and work Rudy established Indiana University as one of the birthplaces of *evo devo*, thereby impacting science both globally and locally. Rudy published three books, *Embryos, Genes, and Evolution* (1983) with Indiana University colleague Thomas Kaufman, which laid the intellectual foundation of *evo devo* and served as its first textbook. This was followed by *The Shape of Life* (1996), which perhaps more than any other book recruited a generation of undergraduate and graduate students to the field. Finally, his autobiography *Once We All Had Gills: Growing Up Evolutionist in an Evolving World* (2012) portrays the growth and promise of *evo devo* through the eyes of one of its chief architects,

in a way that is accessible to nonspecialist readers, and perhaps the next generation of future *evo devo*ists. Similarly, the founding of this journal, and his service as its editor-in-chief for two decades, impacted the field in ways that cannot be overstated. At a time when more narrowly focused journals were reluctant to publish *evo devo* research, *Evolution & Development* was there to provide a platform for discussion, exposure, and encouragement to keep going. Thanks to these efforts, many journals originally focused solely on developmental biology or evolution have more recently begun to broaden their perspectives and now increasingly publish *evo devo* work. As such Rudy's efforts have forever altered the academic and intellectual landscape and resources accessible to researchers in the field. At the same time, Rudy's work immeasurably affected his local environment. For example, he helped organize the fusion of three separate departments into what is now the Department of Biology in 1977, founded the Indiana Molecular Biology Institute in 1983, and helped secure funding from Indiana University, as well as the state and federal government, to renovate Myers Hall, now home to all IU *evo devo* research groups. In all this, too, his legacy lives on, positively impacting in very concrete and productive ways the generations that follow in his footsteps.

We would like to end this dedication as follows: at Rudy's funeral, his daughter Amanda mentioned something we felt was tremendously fitting. She said that what we are now witnessing is Rudy embarking on his last great project, and that is to become a fossil! All those who had the privilege to have known Rudy in person know that he would have loved that remark because he had a great sense of humor and because of how much he loved fossils: the stories they tell, the legacies they reflect, the signatures they leave in what comes after them, and most of all the thinking they inspire. To us, there is no better way to remember the life, work, and friendship of Rudy Raff.

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