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Sam Ward

Genomics has ridden far and fast on a tiny stable of improbable organisms—yeasts, round worms, fruit flies and weeds—that until fairly recently were little known outside the realms of descriptive biology. Sam Ward, professor of Molecular and Cellular Biology at the University of Arizona and the Editor-in-Chief of the ASCB's new journal, Cell Biology Education, has spent much of his career working with one of these once obscure animals, the nematode worm C. elegans.

Yet Ward recalls that he'd never heard of C. elegans until he was finishing his doctorate on bacteriophage assembly under Bill Wood at Caltech in 1971. "There were these rumors out of the UK that Sydney Brenner had picked this strange worm called a nematode," he remembers. "Nobody in the phage group knew what a nematode was in those days. Nothing had been officially published."

The news about Brenner's intentions to isolate mutants in this new model organism intrigued Ward. So he signed on for a post-doc in Brenner's MRC Laboratory of Molecular Biology in Cambridge to work on chemotaxsis as an assay for behavioral mutations. That put Ward into nematodes on the ground floor. He has since moved from studying the nervous system to studying spermatogenesis in C. elegans.

Throughout his career, Sam Ward has been a strong voice for greater balance between teaching and research in biology today. The Ward Lab's award-winning Web site (www.mcb.arizona.edu/ward/ab/topten.html) is that rarest of creatures in cell biology—useful for scientific colleagues and inviting for students. You can download the lab's latest electron micros-copy or its newest papers. You can also click through post-doc Paul Muhlrad's "Ten Top Reasons to Study Worm Sperm" (Reason #8: "Your parents don't brag about your vocation.")

Thousands of labs have since joined the great nematode rush, but in the early days, before gene cloning had been perfected, working with the C. elegans genome was difficult, Ward explains. "Sydney's initial vision was to do a complete anatomy and isolate enough mutants that affect the nervous system to figure out how it works. But it turns out that these mutants had very complicated developmental phenotypes. There wasn't a simple one-to-one correlation between neurons and behaviors."

If the technology was cruder in the early '70s, the time as a post-doc was shorter and faculty research positions more plentiful.

After two years in Cambridge, Ward set up his own molecular biology lab in the Department of Biological Chemistry at Harvard Medical School in Boston, determined to unravel neuronal development using C. elegans mutants he and colleagues had discovered with pro- nounced chemosensory deficits. He soon ran into an experimental brick wall. "I thought, 'Geesh, if anatomy is my only tool, I can't make any sense out of this.' Of course, all this was before gene cloning, but then we accidentally found a mutant that was sterile at high temperatures. This seemed weird. But with further analysis I learned that what was wrong with this mutant was that it was defective in the sperm. I knew nothing about the sperm but it occurred to me in one of those flashes that is supposed to happen occasionally in science that the worm must make a lot of sperm and all the cells must be the same. If I could isolate enough sperm cells, I might be able to do biochemistry and actually analyze the nature of the mutations."

Spermatogenesis in C. elegans turned out to have its own complications, but the ad- vantage of using a type of cell that more or less expressed itself opened a broad avenue for investigation. Says Ward, "My central interest has always been in how genes and their products control the shape and mor- phology of cells. Neurons are just too complicated but in my view a sperm was just a large phage and here was a genetic system you could control while you worked through the sequence of steps controlling morphogenesis."

From Boston, Ward took a new position in Baltimore at the Carnegie Institution of Washington where he joined the now-famous Department of Embryology in 1977. His Carnegie lab post came with a joint teaching appointment at Johns Hopkins, and Ward found himself enjoying teaching again. Unlike many researchers, Ward had never considered teaching to be the lesser skill in science. Over the years, he'd taught a wide variety of students, from gifted California sixth graders to Harvard medical students who seemed grimly intent only on the immediately useful. At Hopkins, he found he liked having undergraduates in his lab. He liked the special summer sessions for high school science teachers who came to Hopkins desperate for new facts, new skills and new materials to take home. It struck Ward how isolated the typical biology teacher was in the typical high school. It made him reflect on the teachers who'd shaped his science.

His first and most important teacher was his father, Morgan Ward, a mathematician at Caltech. A number theorist, "he took great pride that everything that he did had no application at all, that it was there for pure

logical understanding," recalls his son. As a boy, Sam Ward could imagine no finer line of work. "When I was growing up, we spent most of our summers traveling around the desert country of the Southwest, especially the Monument Valley and the Red Rock country. My father always had a book and a pencil so he could work at any time. I remember him getting an idea in his head and writing it on a napkin in a restaurant in Moab. I thought, 'what a great profession.' So when I went to Princeton, I thought I would major in math, but I learned very rapidly that you can't learn to be a mathematician. I was good at math but nothing compared to the other math students at Princeton. They were just at another level."

Princeton also had Colin Pittendrigh, a noted researcher into the circadian rhythms of Drosophila who taught a magnificent two semester lecture course that covered biology from end to end and wrapped it all in an evolutionary perspective. Pittendrigh, to Ward, was a revelation. "Biology in high school had just been this array of disconnected facts, names and observations," Ward recalls. "Then Pittendrigh introduced me to this thing called evolution, and all of sudden biology made sense. There was a connection between all of these observed facts. Some years after I graduated, when I was on faculty at Harvard Medical School, I learned that there were four members of my [Princeton] class, all of whom were in biology faculty positions in the Boston area. We compared notes. Every single one of us became biologists because of this course with Colin Pittendrigh."

This thinking about teachers led Ward in 1988 to accept the position as Head of the Molecular and Cellular Biology Depart- ment at the University of Arizona in Tucson. He took the job, he says, partly to go West again, and partly to join a traditional academic institution that seemed to have a serious commitment to both research and teaching. Shortly after arriving in Tucson, Ward became the PI of a major Howard Hughes Medical Institute grant to enhance the quality of instruction in the biological sciences, both for undergraduates and for high school teachers.

"We've just got to do something about improving the quality of the people we have teaching science today," Ward says. Part of the problem stems from an old attitude in academia that the only students worth teaching are those bound for research careers. Says Ward, "Researchers want to clone themselves and that's unrealistic in the current world. We're growing exponentially in science and we're hitting the limits. We've got more people trained for research than there are jobs available. Nothing can grow exponentially forever. People have to be more realistic about the opportunities students have. I know from watching some colleagues in the past that if a student doesn't express interest in a research career, they lose interest in the student. I think that's absolutely unconscionable in today's educational environment." Ward's commitment as founding editor of Cell Biology Education is the latest manifestation of a career devoted to education.

Ward stepped down as Chair last year, succeeded by Danny Brower. Brower says that Ward was instrumental in changing the science-for-researchers-only attitude on campus. "Fifteen years ago, this university was more polarized in that way," says Brower, "or at least there were people who liked to draw those lines saying that somehow teaching was an impediment to research. I'm happy to say that this is not a battle that's being fought around here anymore. Sam has been one of the people here who have changed that perception."

Today Ward suspects that he may like Tucson so much because of his father's passion for dragging the family around on desert vacations. Outside his C. elegans work, Ward reveals his passion for growing desert flowers. His wife, Anne, is a lawyer and part-time judge. Their eldest son, Timothy, is a computer specialist in St. Paul, MN, who, with his wife Kathy Kerr, recently presented the senior Wards with their first grandchild, Miranda. Sam and Anne Ward's younger son, Geoffrey, works for Friends of the Earth in Washington, D.C. Neither son showed any interest in biology. Geoffrey, his father recalls, explained his college major of political science by saying, "Dad, I wanted a major that had no real facts."

Bill Wood, who was Ward's doctoral advisor at Caltech, adds a few more facts. "The main thing I remember about Sam which still strikes me about him today is his intensity," says Wood. "Sam cares deeply about whatever he's doing, whether it's bench science or teaching. He throws himself into it and makes things happen." Ward certainly threw himself into nematodes, says Wood, who today also works with C. elegans at the University of Colorado in Boulder. He and Ward share another connection to biology history. Their lab in the old Biology Building at Caltech where they worked on bacteriophages had been the laboratory of Thomas Hunt Morgan who came to Caltech in 1928 from Columbia. Here Morgan reestablished his breeding colony of Drosophilia, the humble fruitfly, that Morgan honed into a model organism and the biological probe that opened the way to the modern science of genomics. If cell biology is today a land populated by worms and yeasts, you can add the legacy of the founder of modern genetics as Reason #11 that Sam Ward studies worm sperm.