Magdalena Bezanilla

In biology, there are worm runners, fly people, and even a *Chlamy* clan. There's a *Dicty*Base, a FlyBase, the *Arabidopsis* Information Resource, and since 2006, the online Moss Genome. Moss is the coming thing, according to the supporters of *Physcomitrella patens,* who trumpet its evolutionary placement. In phylogenetic terms, *Physcomitrella* is to flowering plants what *Drosophila* is to human beings—close enough to model basic mechanisms.

For Magdalena Bezanilla, the attraction of *Physcomitrella* was immediate—the moss is unique among land plants because it is a wizard at homologous recombination. Bezanilla, who was introduced to the moss during her postdoc with Ralph Quatrano at Washington University in St. Louis, saw potential in *Physcomitrella*. The moss had the makings of a gene knockout engine. In the Quatrano lab, Bezanilla worked with the newly emerging technique of RNA interference (RNAi) to see if she could knock down genes in *Physcomitrella.* Because the moss's genes are haploid during its gametophyte stage, Bezanilla did not have to worry about a second endogenous version of the targeted gene coming to the rescue.

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In 2005, Bezanilla set up her own moss lab at the University of Massachusetts (UMass), Amherst, and the stars have been coming together ever since for "*Physco.*" Quatrano and the worldwide moss community soon finished sequencing the genome, creating a searchable index of promising targets. Bezanilla refined her RNAi techniques for *Physco* into a high-speed reverse engineering system. All this, however, should be seen only as a means for Bezanilla's great quest—tracking the myosin superfamily and all the attendant actin-related machinery of cell morphogenesis in plants.

It is an ambitious research program for an assistant professor, but Bezanilla's work on developing the moss knockout engine plus papers on myosin XI, formins, and other active agents in plant cell morphology have already attracted attention in the plant cell community and beyond. In December, Bezanilla will receive the Women in Cell Biology Junior Career Recognition Award at the ASCB Annual Meeting in Philadelphia. Early next year, Bezanilla will be invited to the White House to receive a Presidential Early Career Award for Scientists and Engineers citation from the hands of President Obama.

Sorting Out Myosins

In nominating Bezanilla for the WICB Junior Award, her PhD mentor, Tom Pollard, described how she followed her own path to explore the cytoskeleton in plants: "Plants use actin filaments much like animal cells use microtubules for organelle transport. Moreover, plant myosins hold the world record for speed among all the molecular motors. These intriguing observations have been waiting for the right person to sort them out. Magdalena is that person. Plants offer many more experimental challenges than fungi, but the efficient RNAi method that she developed for moss as a postdoc has circumvented many of the limitations. This innovation is the breakthrough that she needed to attack her long-term goals to characterize actin-based motility in plants."

"That's the thing about Magdalena. It's always about the question," says Debbie Liang, her close friend from graduate school days at the Salk Institute. "She was really interested in this question of the myosins and how they functioned." Moving into plants and especially moss gave her a whole new realm in which to explore the myosin question, says Liang. "She's so passionate about the subject that she got really excited when she found this new way to study it. Besides, in plants, myosins were something new that hadn't been studied to death."

Bezanilla was born in Rochester, NY, where her Chilean parents were living while her father, biophysicist Francisco Bezanilla, was a visiting assistant professor at the university. The family returned to Chile, but under the polarizing

Photo by Graham Burkart

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Pinochet regime her father found it impossible "to get any science done," says his daughter. They returned to the U.S. and finally settled in west Los Angeles, where her father was for many years on the physiology faculty at the University of California, Los Angeles (UCLA). (Emeritus at UCLA, Francisco Bezanilla is now continuing his research at the University of Chicago.)

Growing up in a scientific household, Magdalena Bezanilla was always fascinated by science, although her childhood ambitions moved from astronaut to astronomer to physicist. She was all set for the University of California, Berkeley, when a pamphlet from the College for Creative Studies (CCS) at the University of California, Santa Barbara, intervened. On a summer CCS research internship in the lab of Peter and Helen Hansma, physics and biology crossed paths as Bezanilla learned how to use atomic force microscopy to image DNA. "That's when I got really intrigued by the kinds of questions biologists were asking," she recalls. "I always knew what biologists were doing because of my dad, but [in the Hansma lab] I could see that there were many more open questions in biology than in physics."

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Lab Goes West

Taking her physics degree to pursue biological questions led Bezanilla to a PhD program at the Johns Hopkins Medical School in Baltimore. But a frustrating first lab placement left her rethinking the future until her then-boyfriend now-husband, Wei-Lih Lee, came home from his weekly meeting in the Pollard cytoskeleton lab. Pollard had announced that the whole lab was moving to the Salk Institute in San Diego, Lee told her. Bezanilla resolved to somehow convince Pollard to let her transfer into his lab just as it was about to move 3,000 miles. "I still don't know why Tom took me," says Bezanilla.

Whatever his reasons, Pollard sent Lee and Bezanilla out to San Diego to get established. (They both later returned to Hopkins to defend their dissertations and take Hopkins degrees.) In the interim, Bezanilla found herself a guest in the yeast genetics lab of Susan Forsburg, where she learned the basics of reverse genetic engineering. It was Bezanilla, according to Pollard, who "single-handedly" introduced fission yeast genetics to his new Salk lab for studying myosin in the cytoskeleton. For her thesis, Bezanilla says she got lucky when she spotted the gene for a myosin-II that Pollard had just asked her to characterize already posted on a sequencing update board. The online sequence provided the short cut, but it led to hard work knocking the gene down and then searching for the right conditions that would reveal the phenotype. Her gene, Myp2, turned out to produce an unusual myosin-II with a folded coiled-coil and drew her even more deeply into the myosin puzzle.

It was the tomato that led her to plants, Bezanilla recalls. "One week, I happened to choose a paper about the cytoskeleton in tomatoes for journal club." First at Hopkins and then at Salk, all of Bezanilla's biology education had come in a medical research context. Plants were a new world to her. "This paper really intrigued me. I read a few more papers about the plant cytoskeleton and quickly discovered a huge gap in knowledge between the animal and plant cytoskeleton fields."

Bezanilla widened her reading. The first myosin phylogenies in plants were just being described and it was clear that plants had evolved unique myosins. She ran across references to *Physco* and its unique power of homologous recombination. Her interest in moss led her to Quatrano and through her postdoc work in St. Louis to introductions to the global moss community. In 2005, Bezanilla says that she and her husband were lucky to land double job offers from UMass, Amherst.

Keynote Material

Pat Wadsworth, a senior member in the UMass biology department, claims that it was her department's luck. Wadsworth says that she's never seen a green faculty member pick up the roles of an academic researcher as quickly as Bezanilla. Within a year, Bezanilla was smoothly juggling bench work, papers, grants, teaching, service, and mentoring like a veteran, says Wadsworth. A revelation came to Wadsworth at an interdepartmental graduate program annual retreat soon after. A celebrated scientist had been brought in from the outside to give an inspiring keynote and was followed to the podium by Bezanilla, representing upcoming junior faculty. "I don't remember who the outside speaker was, but I do remember sitting there thinking that

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Today, Bezanilla and her husband live in Amherst with their two sons, Matias, 7, and Diego, 3. Outside of her myosin quest and the intense demands of raising small children, Bezanilla admits to being a serious follower of major league baseball. During her graduate studies in San Diego, she was a Padres fan. During her postdoc in St. Louis, her allegiance tipped toward the Cardinals. So now in western Massachusetts, has Bezanilla joined Red Sox Nation? No way, she says. "I have a hard time with the American League," Bezanilla declares. ■

—John Fleischman