People & Ideas

Rebecca Heald: Passionate about cycles

Rebecca Heald uses cutting-edge microscopy techniques to explore the cytoskeletal dynamics of cell division.

When she isn’t cycling up a mountain, Rebecca Heald is blazing new trails in cell biology. Her work on dynamic cytoskeletal structures involved in mitosis and meiosis—particularly the microtubule-based mitotic spindle—has continually set the pace in her field.

After completing her graduate studies on nuclear lamins in Frank McKeon’s laboratory at Harvard (1), Heald sought a change of scenery and research project. She moved to Germany where she joined Eric Karsenti in pursuing the mysteries of the microtubule cytoskeleton. A fortuitous collaboration led Rebecca to make a breakthrough in the field of spindle biology: DNA alone can nucleate the formation of a bipolar mitotic spindle apparatus (2).

Since returning to the United States, Heald and her many collaborators at the University of California, Berkeley, have continued to probe the mysteries of the mitotic spindle (3–5). She’s a tough person to catch, but she slowed her pace long enough to discuss her experiences with us.

"An important thing for success is to figure out where your aptitude lies."

When did you discover your niche?

It evolved throughout graduate school and my post-doc. I’ve always been interested in dynamic cell structures, and their morphogenesis. As a graduate student I discovered microscopy, and loved it. I had been using it to study nuclear lamins, which are intermediate filaments. They have some dynamic behaviors, but they’re not as dynamic as other cytoskeletal proteins. Microtubules are really the ultimate dynamic cytoskeletal element. So, for my post-doc I decided that I wanted to study them. But I also wanted to do it in a completely different kind of environment, in Europe.

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because Eric had micro-injected viral DNA into eggs and seen microtubules form around it. I wanted to see whether my chromatin-coated beads had this activity before I tried to purify the phosphatase, because purifying the phosphatase would necessitate using the swinging bucket centrifuge (I was actually terrified of these rotors) and chromatography—all stuff that I don’t like nearly as much as microscopy. So I twiddled with the chromatin-coated beads, and then started to see, not only microtubules, but also bipolar spindles that self-organized around the beads. And suddenly I had this very accessible system with which to study this process. It wasn’t that the concept was completely new, but it was a big breakthrough.

It moved both the field and your career forward.

Yeah, and as a result I got this great job at Berkeley. I actually interviewed in Europe as well, but at that point I thought that maybe the beads would be it for me. Maybe that would be the only thing that’d ever happen, the only major paper I’d ever have, so I’d better get a grant while the iron was hot. What if I stayed in Europe and floundered, and then ran out of money, and got stranded? But I think what I’ve realized since I started my laboratory—and, if I’d thought about it, might’ve realized as a post-doc—is that I do the best science when I interact with people from different areas of expertise. For example, the chromatin-bead experiment arose from my interactions with a laboratory down the hall. When you start your own laboratory, at first you think, “Oh, I have to just hunker down and figure everything out for myself.” But I’ve realized that what I’m really good at is collaborating and identifying interdisciplinary projects. Most scientists are really open to combining forces and sharing the credit, and I think scientists shouldn’t be afraid to work together more, to take risks and try out some far-fetched ideas.

What ideas are you pursuing in your laboratory right now?

The hot topic in my laboratory right now is intracellular scaling. We tend to work with egg extracts from Xenopus laevis for our mitosis studies. But recently I had a rotation student who made extracts from the eggs of Xenopus tropicalis, which is a smaller, related frog that lays smaller eggs. She made a really exciting observation—the extracts from tropicalis eggs generated smaller spindles even when we used the same chromosomes that we’d used in the laevis egg extracts. And if you mix extracts from both species, you get intermediate-sized spindles and nuclei.

Some cytoplasmic activity determines how these structures intrinsically scale themselves, so we are thinking about whether this might explain how cellular structures and organelles shrink during development—when the egg divides into smaller and smaller cells. And now we have a system to study this. JCB