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PEOPLE & IDEAS

Vaishnavi Ananthanarayanan: Advocating for women's representation in science

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Vaishnavi Ananthanarayanan investigates the regulation of motor proteins and cytoskeleton–organelle interactions using single-molecule microscopy.

Growing up, the crimes from Agatha Christie's novels were far from being the only mysteries that Vaishnavi (Vaish) Ananthanarayanan was determined to unravel. It didn't take her long to trade the detective's magnifying glass for a microscope to find the missing pieces of the inner workings of cytoskeleton motors. Vaish left Puducherry (formerly Pondicherry), a coastal town in South India where she grew up, to study a double major in biology and computer science at the Birla Institute of Technology and Science, Pilani, India. After doing a 1-yr internship with Bill Thies at Microsoft Research India, Vaish moved to Germany for her PhD. She joined the laboratory of Iva Tolić, at the Max Planck Institute of Molecular Cell Biology and Genetics (MPI-CBG), Dresden, who introduced her to single-molecule microscopy. Her thesis work revealed that binding of dynein to cortical anchors activates dynein on the microtubule.

What happened shortly after Vaish defended her thesis in January 2014 was kind of uncommon, though exciting: She became an independent researcher at the Indian Institute of Science (IISc) in Bangalore, India, in June the same year. Her team studies how cytoskeleton and motor proteins influence the organization and function of cellular organelles. Vaish recently relocated as a European Molecular Biology Laboratory Australia group leader to the Single Molecule Science Node, University of New South Wales (UNSW) in Sydney, attracted by the advanced microscopy facilities at UNSW and the interdisciplinary program that brings together biologists, physicists, and engineers.

An advocate for women's equity and representation in science, Vaish is the cofounder of BiasWatchIndia and the recipient of the 2021 Women in Cell Biology (WICB) Junior Award for Excellence in Research from the American Society for Cell Biology (ASCB). We contacted her to learn more about her projects inside and outside the laboratory.

What interested you about motors and microtubules? And why did you choose yeast as your model system?

Motors and microtubules were the focus of my thesis. I knew almost nothing about either when I got into the PhD program in biophysics, but once Iva showed them to me under the microscope, there was no going back! It's mind blowing that the cellular transport largely relies on miniscule motors and microtubule tracks that not only ensure the delivery of cargo proteins to the right place within the cell but the positioning of entire organelles and their function—motor proteins can generate forces and control essential processes such as cell differentiation or mitosis. Yeast cells were the preferred system of Iva's laboratory because of their simplicity—unlike mammalian cells, yeasts have around three to five microtubule bundles, so it's much easier to observe the dynamics of a single microtubule, and they are easy to manipulate genetically. They were perfect for the questions I was trying to answer. Although yeast is close to my heart, the truth is that I did not intend to use it anymore when I started my independent group at IISc—I was ready to untangle the motor-microtubule mesh of mammalian cells. I had a comprehensive plan of using human cells for all our future work and oh, I'd have never guessed that my old yeast friend would later be my best ally! There were unexpected delays in getting the infrastructure up for mammalian cell culture, and so I went back to yeast to set our research in motion in a timely fashion.

Vaishnavi Ananthanarayanan. Photo courtesy of Vaishnavi Ananthanarayanan.

What are you currently working on, and what is up next for you?

One of the questions we are still working on since I started my laboratory is how cytoskeleton and motor proteins control distinct

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Mitochondrial dynamics in fission yeast cells. Each row represents an individual cell, imaged every 10 s. Image courtesy of Vaishnavi Ananthanarayanan.

biological processes, such as mitochondrial dynamics. We discovered that microtubule length regulates mitochondria fission (1) and that the segregation of yeast parental mitochondria depends on its tethering to the plasma membrane by the dynein anchor Mcp5/Num1 (2). We also described that the myosin I motor Myo1 facilitates nuclear oscillations and, essentially, dynein activity during meiotic prophase in yeast (3). Another question that keeps me up at night is how dynein activity is spatially and temporally regulated for cargo trafficking. We have recently found that cytoplasmic dynein stochastically and transiently interacts with the microtubule, and when it binds to a dynactin–cargo complex in proximity of the microtubule, it becomes activated (moves toward the minus end of microtubules); long-range movement of cargoes in human cells require several rounds of such stochastic interactions (4). We use different live-cell, advanced imaging techniques, including super-resolution microscopy, correlative light and electron microscopy, and highly inclined and laminated optical sheet microscopy that allows for visualization of single molecules within the cytoplasm of living cells. Basically, the overarching goal is to unravel how stochastic and rare interactions between motor proteins and the cytoskeleton determine the complexity in cellular organization, and we are equally interested in doing so during homeostasis and in a disease context, such as neurodegeneration or cancer.

What did you learn during your training that helped prepare you for being a group leader? What were you unprepared for?

During my PhD at the MPI-CBG, I actively learned how to do good science. Due to Iva's influence, I imbibed the best practices when it came to asking solid scientific questions and writing manuscripts and grants. I was largely unprepared for running a laboratory otherwise, and the implicit and explicit bias against women in Indian academia made my start even more challenging. I based my mentoring style on that of Iva's, and I'm grateful I had such a great role model. I am still learning—I rely heavily on my team in defining our laboratory's ethos and setting our culture. We are hoping to foster a welcoming, inclusive, and diverse environment where we all have fun doing our science.

Last year, you cofounded BiasWatchIndia, an initiative to document representation of women speakers at STEM conferences in India. What inspired you to create this initiative?

In mid-2020, when we were well and truly in the midst of a pandemic, all conferences went virtual. So local conference announcements in India were almost exclusively made online on platforms such as Twitter. It therefore quickly became apparent just how much women were underrepresented in Indian STEM meetings, and also how prevalent "manels" (panels of men only) were. Dr. Shruti Muralidhar (then a postdoctoral fellow at Massachusetts Institute of Technology, now research scientist at Deep Genomics) pointed this out in a tweet and sought to understand if an initiative like BiasWatchNeuro (https://biaswatchneuro.com) would make sense in the context of Indian science. Having already worked in the sidelines toward improving the retention of women in Indian academia and being acutely aware of the inequity, I quickly put my hand up and we teamed up to found BiasWatchIndia (https://biaswatchindia.com) to document women representation in Indian STEM conferences and to collate data on the proportion of women in Indian STEM—these data are surprisingly not publicly available in India!

What is the impact you think BiasWatchIndia will have in Indian science in the long run?

It has been hard work—we have faced backlash and trolling just for pointing out the obvious. On the other hand, we also have instances of people's change of mind (and of speaker lineup!) after engaging with us. We are hoping to engage with the Indian science administration and with the scientific community on other fronts to make real change in the conversation and perception of women and other minorities in Indian science.

Vaishnavi Ananthanarayanan jet-skiing with her partner Sumeet Yamdagni in Langkawi, Malaysia. Photo courtesy of Vaishnavi Ananthanarayanan.

You have been awarded the WICB Junior Award for Excellence in Research by the ASCB this year—congratulations! What does this award mean to you?

I was truly honored to receive the award—I honestly did not expect it. I learned that I was going to be the one receiving it this year at a time that I was just recovering from a major illness. I had taken a prolonged break to recuperate as a result and was also going to be unable to go back to work for a while due to the COVID-19 lockdown in Sydney. I remember being stressed out about how I was going to get back on track with research and other responsibilities. Getting to know about this award at such a time was a great reminder to me how far we'd come as a laboratory and gave me the much-needed motivation to keep going not just with our research program, but also our work with BiasWatchIndia.

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