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Is cellulose synthesis a Brownian ratchet?

Despite its importance for the plant and for humanity, cellulose is made by a mechanism that remains enigmatic. In the test tube, cellulose is synthesized with difficulty or not at all, limiting the standard tools of biochemistry. We do know that cellulose is made by an enzyme complex at the plasma membrane. The complex takes (activated) glucose from the cytosol and polymerizes it into unbranched chains, where the glucose moieties are linked in a way that allows the chain to adopt a linear conformation. The complex makes (probably) 18 chains, which after extrusion from the enzyme complex crystalize into a microfibril. As the microfibril gets extended, the complex moves in the plasma membrane. We do understand neither how the 18 chains coalesce into a crystalline microfibril nor how crystallization in effect pushes the enzyme complex. To illuminate this process, we imaged the motion of the synthase tagged with a fluorescent protein at high resolution. Based on analyzing the trajectories and fitting them to models for assisted diffusion, I will attempt to answer the question posed in the title.

Tobias Baskin was first pushed on by forces in Biology when as an undergraduate student he read D'Arcy Thompson. He worked with Paul B. Green at Stanford University for his Ph.D and then did postdoctoral research, first with Zacchaeus Cande at UC Berkeley and after that with Richard E. Williamson at Australian National University. He joined the faculty of the Biology Department at the University of Missouri Columbia in 1992 and moved to the Biology Department of the University of Massachusetts Amherst in 2003, where he is a Professor. In general, Baskin works on anisotropic expansion of the cells and organs of plants.