© 2023. Published by The Company of Biologists Ltd | Journal of Cell Science (2023) 136, jcs261056. doi:10.1242/jcs.261056

EDITORIAL

SPECIAL ISSUE: CELL BIOLOGY OF MOTORS

The cell biology of motors

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I am delighted to introduce this Special Issue on the 'Cell Biology of Motors'. Molecular motors are fascinating proteins, and we can observe the motility that they produce – the twitching of muscles, the beating of flagella, cytoplasmic flows – with our naked eye or with very simple microscopes. However, it is not immediately clear how a bunch of proteins can generate such motility. During the past two decades, structural biology, single-molecule imaging and force spectroscopy approaches have revealed in detail how myosin, kinesin and dynein step along cytoskeletal tracks, coupling each step to the hydrolysis of ATP. The attention of the field is now focussed on the mechanisms underlying how motor activity is controlled and coordinated, understanding how different motors specialise in modifying and organising tracks, and how cargo transport specificity arises.

My own research group aims to understand how microtubule motors are activated and loaded with cargo and how they contribute to the organisation of the underlying network of microtubule tracks. To do this, we combine quantitative cell biology with biochemistry, *in vitro* reconstitution and single-molecule biophysics. This combination of techniques allows the thorough testing of mechanistic hypotheses that can explain how motors function in cellular processes. Likewise, many studies featured in this special issue combine cell biology with *in vitro* reconstitution or mathematical modelling. The issue covers the full range of molecular motors, including different types of myosins, kinesins and dyneins, as well as a variety of experimental systems, including mammalian cells, mice, *Drosophila* pupae, *Xenopus* tadpoles, sea urchin eggs and fission yeast. Motors are investigated during cell division, intraflagellar transport, ciliary beating, cargo sorting, organelle homeostasis, viral egress, cell migration and morphogenesis. As a personal highlight, Xu et al. reveal a surprising answer to one of the key unresolved questions in the field, namely how many motors bind to one cargo in a cell (Xu et al., 2023). For vaccinia virus, it's in the order of 100–300 motors, suggesting that some viruses assemble an entire coat of kinesins. Previous studies have suggested that only a few motors per cargo are engaged with the microtubule at any one time (Levi et al., 2006; Hill et al., 2004; Miller and Lasek, 1985). If both sets of observations are true, the number of motors that accompany cargo as passive passengers might exceed those that are at work by at least one order of magnitude. Thus, the common view that cargo binding equates with motor activation might require re-evaluation, and the principle that autoinhibited dynein is packed onto anterograde intraflagellar transport trains might apply more generically to cytoplasmic cargoes.

The special issue also includes a number of comprehensive and thoughtful review-based articles that summarise and discuss some of the most exciting and recent developments in the field. This includes indirect cargo transport via bulk cytoplasm flow generated by motors sliding along microtubules, the coordination of bidirectional transport, the recruitment and turnover of motors at cargoes and subcellular structures, and understanding diseases caused by mutations in genes encoding motor proteins. It is in those areas where big strides are being made to understand how molecular motors work in their natural habitat in living cells.

I hope you will find something in the special issue that excites you and inspires your research. I'd like to thank all the authors who contributed to the special issue, as well as the reviewers, who provided expert help. I also encourage you to submit your next article on this exciting topic to Journal of Cell Science – a community-focussed journal. Do also come along to the 'Motors in Quarantine' webinar series (https://mechanochemistry.org/whatson/MiQ), which provides the motor community with an opportunity to discuss the latest findings in the field.

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