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FOCUS: MICROSCOPY AND IMAGING

Introduction

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When Anton van Leeuwenhoek looked through his early microscopes in the 1600s, he realized that the world was teeming with microbial organisms, invisible to the naked eye. Since then, advances in biology and medicine have depended upon ever-developing technologies to visualize and enlarge the natural world. Where would medical diagnostics, cell biology, and immunology be today if not for the invention of X-ray radiography? Or without the development of transmission electron microscopes that reveal the detailed structures of cellular organelles? Without the fusion of fluorophores with antibodies to illuminate specific antigens?

For our Focus Issue on Microscopy and Imaging, we have selected articles that highlight the most cutting edge imaging techniques in modern biology in the context of the unique research questions that motivated their use and development.

First, we see how the two-photon intravital imaging methodology developed by Linda Bockenstedt and colleagues contributes to a growing picture of the transmission of Lyme disease. Here, the technique reveals the motion of tick mouthparts during feeding as Lyme disease spirochetes circulate through the dermis of a live mouse. Then, Michael Pendleton et al. describe work using SEM-EDS and Micro-XRF-SEM to detect elements present on pottery from the American Southwest, a technique that could have applications for analysis of hard tissue samples.

Our Focus Issue also includes two reviews. Joseph Wolenski and Doerthe Julich examine advances in the capacity of major fluorescent microscopy techniques to achieve higher resolution images with faster acquisition speeds, focusing on the advantages of light sheet microscopy for tracking single cells in live embryos. Evan Morris and colleagues review the design of PET experiments to study neurochemistry, emphasizing applications to alcoholism research.

Finally, we had the pleasure of interviewing Derek Toomre, who gave us a primer on state-of-the-art optical techniques being used at the Yale CINEMA laboratory and nationwide. He describes the TIRF superresolution microscope that he helped develop from a research prototype into a commercial instrument and which he now uses in his lab to study cellular exocytosis in connection with disease.

Viewed as a whole, this collection of articles showcases the rapidly evolving nature of microscopy and imaging. We hope that it will serve as a resource for understanding and applying these powerful imaging approaches to new research questions across a spectrum of disciplines.

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