GUEST EDITORIAL
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Advanced microscopy and novel methods in microbiology

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Microbiology, like all the sciences, is founded upon the twin pillars of craft techniques and philosophical speculation. Without the empirical observations of the first, the subject would be but a meaningless verbiage, and without the organizing hypotheses of the second, would be but a collection of descriptions and receipts.

Patrick Collard, 1976

The beginning of modern microbiology starts from the late 1800s building on the advances made in chemistry, physics, and evolutionary cell biology and development of experimental and microscopic methods in the preceding centuries. Antoine van Leeuwenhoek did the pioneering work in microscopy in the 1670s and contributed toward establishment of microbiology as a scientific discipline. Microbiology has been through many different eras starting from the 'speculation' like the 'spontaneous generation' to current genome level understanding. In the first golden age of microbiology (1857–1914) causative agents of diseases (e.g. the Germ Theory of Disease), the role of immunity in preventing and curing disease (e.g. smallpox) and the chemical activities of microorganisms (e.g. fermentation) were identified. Key techniques like culturing microorganisms and subsequent microscopy as well as development of vaccines (e.g. rabies) and aseptic surgical techniques (e.g. the use of phenol) were introduced. In the second golden age of microbiology (1910 onwards) discovery of antibiotics and 'chemotherapy' eventuated with the key contributions from Alexander Fleming and Howard Florey who were able to produce the first antibiotic for clinical use. In the third golden age of microbiology molecular tools have significantly advanced our understanding of microorganisms at the genome level. Molecular diagnostic tools rapidly revolutionising the medical field and the treatments for the better: examples include shotgun metagenomic sequencing pathogens, microsatellite instability analysis systems, nanotrap virus capture kits as well as increasing affordability of PCR-based assays.

In this special issue of *Microbiology Australia*, we thus highlight advances in microscopy and novel diagnostic and microbiological methods. These technologies provide advances in understanding microorganisms, including their interactions among each other as well as with higher organisms. Their further exploitations provide valuable products for the needs of society.

In this special issue of *Microbiology Australia*, we thus highlight advances in microscopy and novel diagnostic methods. Tom Olma highlights the automation in diagnostics, Sarah Kidd and Gerhard Weldhagen communicate the diagnosis of dermatophytes. The article on the role of long read sequencing in fungal identification and diagnosis of mycoses reflects on the superior features of the methods by Laszlo Irinyi, Minh Thuy Vi Hoang and Wieland Meyer. Microbiology has provided the knowledge for industrial advancements: an example is shared by Ian Macreadie and Sudip Dhakal in an article titled 'The awesome power of yeast' as a cell factory for valuable proteins, including vaccines and new therapeutics. An example of microscopic techniques is covered by Pranali Deore, Iromi Wanigasuriya, Sarah Jane Tsang Min, Douglas R. Brumley, Madeleine van Oppen, Linda L. Blackall and Elizabeth Hinde with an article on the non-traditional approach to study microbial ecophysiology using fluorescence lifetime imaging microscopy (FLIM). İpek Kurtböke shares her experiences with actinomycete imagery dating back to 1980s. Douglas R. Brumley reveals the improvements in understanding processes in microbial ecology using mathematical modelling and quantitative video microscopy. A laboratory report is communicated by Laura G. Dionysius, Peter R. Brooks and İpek Kurtböke on the use of streptophages to control odorous streptomycetes on nuts. The issue concludes with the hot topic article on COVID-19 vaccines by Paul Selleck and Ian Macreadie covering a summary of technologies developed to produce 140 COVID-19 vaccines, which are recognised by the WHO as being in various developmental phases.

COVID-19 once again highlighted the importance of rapid diagnosis, vaccine and antimicrobial drug development. Super-fast vaccine delivery was possible due to the collaboration between scientists, manufacturers and distributors as well as ongoing background research before the virus has appeared. SARS (2002) and MERS (2012) investigations gave vaccine designers a head start. Ehrlich's vision 'the goal is to find chemical substances that have special affinities for pathogenic organisms and that, like magic bullets, go straight to their targets' only became a reality after 40 years of research. Accordingly, investment into research and development is a must for the generation of sound knowledge platforms that will provide the base for future discoveries.

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