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When single cell technology meets omics, the new toolbox of analytical biotechnology is emerging

Editorial overview

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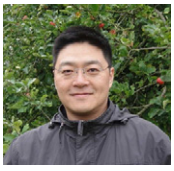

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All cells on the earth may originally descend from a single cell LUCA (last universal common ancestor) that appeared about 3.6 billion years ago. All organisms including complex organisms such as a human body start from one single cell. Multi-cellular organisms develop and produce functionally distinct cells and tissues via cell differentiation; and single cell organisms such as bacteria produce various phenotypes to rapidly adapt changing environment, even though those tissues and bacteria are genetically identical. The cellular heterogeneity in an isogenic population (each cell possessing the same genetic composition) has a profound implication on cell fate, evolution and complexity of life. Microbiologists have a special interest in single cells because the vast majority of microbes (>99%) in their natural environment have not yet been cultivated using traditional culture-dependent approaches. Those uncultured bacteria may play an important role in ecosystems, which is crucial for us to understand ecosystem functioning, global carbon/nitrogen cycles, human health, and which is also a potential 'gold mine' of novel genes. Hence, modern cell biology requires analytical biotechnology moving on to look at single cells instead of conventional ways that measure and analyse a cell population as averaged bulk. With advances in DNA sequencing and information science, cell biology is extended to omics era, which is to collectively measure characteristic of DNA, RNA, protein, metabolites and to explore their interactions to make up the various types of the cells of an organism. Omics could provide large-scale and holistic data/information to cells, and potentially single cells. When single cell technology meets omics, the new toolbox of analytical biotechnology is emerging.

''*Progress in science depends on new techniques, new discoveries and new ideas, probably in that order*''. — Sydney Brenner

The marriage of single-cell and omics techniques will open a new door for biologists and promote a new frontier of cell biology. The toolbox will help understand when and how the different cell-fates are signalled and selected and subsequently how the cells are differentiated; and to dissect the function of microbial community that are resisted to be cultured. Thanks to the contributors, this issue brings you the toolboxes of single cells analysis and omics, which include microfluidic-based analysis, single cell manipulation, label-free single cell sorting and imaging, quantitative measurement of single cell dynamics, genomics, transcriptomics, proteomics, interactions of macromolecules, metabolomics, analytical tools for marine biology, metagenomic data analysis, and biochemical network analysis.