

**Annual Review of Cell and Developmental Biology, 2017.** Randy Schekman, Larry Goldstein and Ruth Lehmann (eds). Annual Reviews, 4139 El Camino Way, Palo Alto, California, 94303-0139, USA. Vol. 33. ix + 603 pages. Price: US\$ 114.

The *Annual Review of Cell and Developmental Biology* is eagerly awaited by the scientific community, as the reviews are not a mere documentation of references but also discuss current state of research in the areas covered and the problems that remain to be addressed. There are 25 reviews in this volume, including perspectives. The 'Introduction' by Randy Schekman (one of the editors) is entitled 'The challenge to science in the arena of public policy'. Schekman expresses concern on the misrepresentation of science for political purposes. He argues that while scepticism should be welcomed, the challenge should be based on scientific principles and not blind dogma. While the article is US-centric, it is highly relevant to all countries.

The 'Perspective' by Richard McIntosh is entitled 'Assessing the contributions of motor enzymes and microtubule dynamics to mitotic chromosome motions'. Beginning on a historical note starting from 1960, he describes aspects of cell biology of anaphase A and B, highlighting microtubule dynamics.

An important aspect that is evident from the reviews is the extensive use of molecular biology techniques in order to get deeper insights in well-investigated areas that would have been classified as 'classical developmental biology' in the past. The reviews also indicate the extensive use of techniques such as super-resolution microscopy and proteomics in cell and developmental biology.

The role of microtubules in cell biology has been extensively studied for several years. Two reviews are related to microtubules. Banterle and Gönczy review various aspects of centriole biogenesis, bringing out the beauty of its architecture. The proteins involved in centriole assembly are described in detail. This has been evidently aided by mass spectrometry. The authors conclude that the assembly principles of the biogenesis would be deciphered almost 100 years after the term 'centriole' was put forth by Boveri. Wu and Akhmanova discuss microtubule networks with respect

to chromosome segregation, positioning and transport of different organelles, cell polarity and morphogenesis. The review provides recent insights, particular advances in the past 5–6 years. Different aspects of cell polarity in yeast are reviewed by Chiou *et al.* They have studied the process in both budding and fission yeast. The review discusses conserved and species-specific features.

Petrou *et al.* discuss the hedgehog signalling pathway. This pathway plays an important role in embryogenesis and actually has been the subject of intense research, particularly genetic analysis. Figure 1 outlines the important cellular processes in the hedgehog signalling pathway and is also the focus of the review. The future issues raised by the author would be of interest to those who intend to work on the biochemical aspects of the hedgehog signalling pathway. Cell removal is crucial to development. The review by Henson deals with cell removal, particularly, efferocytosis. The term is used to describe uptake and removal of cells undergoing non-apoptotic form of programmed cell death. The review describes selectivity of cell recognition, mechanism of uptake, ingestion of cells and connection between defects in cell clearance and tissue homeostasis, as well as disease processes. The author speculates that efferocytic cell removal could have implications in therapies. The review by Devreotes *et al.* is entitled 'Excitable signal transduction networks in directed cell migration'. The complexity of events involved are highlighted, which include videos that can be accessed on-line. The physics aspect such as shear stress and oscillations is discussed with illustrations that will be of use to the non-specialist.

*Drosophila melanogaster* as a model system is the subject of three reviews. Kiehart *et al.* review 'Cell sheet morphogenesis: dorsal closure in *Drosophila melanogaster* as a model system'. They discuss mechanics of dorsal closure from a physics point of view. It is clear from concluding remarks that the dorsal closure problem can still be an attractive area of research. The review by Doe is focused on temporal patterning in the *Drosophila* central nervous system (CNS). In the 'Introduction', the author states that in an earlier review on this topic in 2004, only five *Drosophila* temporal identity papers were covered, whereas the present review covers more than

50 papers on the subject, indicating the interest and progress on the topic in the last 13 years. In their concluding remarks, the authors examine whether the fly temporal transcription factors and their mammalian counterparts have similar functions. Leung and Montell in their review entitled 'Unconventional roles of Opsins', discuss the light-independent roles of opsins using *Drosophila* as a model system. The authors then review extra-ocular light-dependent function of opsins as well as light-independent roles that are increasingly being appreciated.

Interspecies chimeras have been a popular theme in mythology the world over. This has led to the belief that knowledge of stem cell biology existed during ancient times. The review by Suchy and Nakauchi is entitled 'Lessons from interspecies mammalian chimera'. The authors clearly define what is a chimera, in the 'Introduction' section. They dwell on interspecies mammalian chimeras. They also discuss in detail interspecies organogenesis emphasizing generation of human organs in livestock animals.

The review by Yu and Ren is devoted to three-dimensional organization of mammalian genomes. They begin the review by discussing tools to study 3D genome organizations and then focus on various aspects of 3D genome organizations and gene regulation. At the end, they discuss the roles of 3D genome organizations in disease and cancer. DNA replication has been the subject of extensive research over several decades. Snedeker *et al.* review the inherent asymmetry of DNA replication and discuss recent advances in the area. Meyer and Jaffery review *N*<sup>6</sup>-methyladenosine m<sup>6</sup>A. The modification m<sup>6</sup>A is found in mRNAs and non-coding RNAs that have an effect on various facets of RNA biology. The authors describe in detail m<sup>6</sup>A mapping approaches, m<sup>6</sup>A readers, m<sup>6</sup>A writers and m<sup>6</sup>A erasers. The prediction



Rat-mouse chimeras generated by pluripotent stem cell microinjection.

## BOOK REVIEWS

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that m<sup>6</sup>A is likely to be a modification that would have the ability to control gene expression made in the 1970s, is clearly borne out by the extensive work since then. The authors conclude that further work on m<sup>6</sup>A would have relevance in human health and disease. Joazeiro reviews 'Ribosomal stalling during translation: providing substrates for ribosome-associated protein quality control'. Specifically, ribosomal stalling and rescue steps upstream of ribosome-associated quality control (RQC) are discussed. The discovery of RQC is relatively recent and therefore a good research area to work on.

Protein translocation has been the subject of intense research, particularly after Gunter Blobel's 'signal hypothesis'. Multi-faced approaches, including the work by Rapoport, have delineated details of the process. Hence one might wonder whether a review in this area is really necessary. The subject was also covered in several articles paying tribute to Blobel, who died recently. The review by Rapoport *et al.* is confined to the crystal structure of sec proteins and discusses the molecular mechanism of protein translocation across membranes via protein channels. The review by Chio *et al.* is also on protein biogenesis. How the C-terminal trans-membrane domain can act as a specific targeting signal has been a puzzle. Aspects of tail-anchored membrane protein targeting and insertion are discussed. Lipid droplets, an area that is extensively investigated, are reviewed by Walther *et al.*

The review entitled 'In search of lost small peptides' by Plaza *et al.* would appear out of place in this volume. It describes small/short open frame smORF encoded peptides that have not been prospected for bioactive peptides. The

review also highlights different approaches used to unravel small peptides. The biological relevance of these peptides is discussed. As indicated by the authors, these peptides could be attractive candidates as future therapeutic agents.

Protein homeostasis is crucial to cellular physiology and has widespread ramifications. Pilla *et al.* discuss several aspects of protein quality control systems (PQC) – a network of factors and pathways which ensure that proteins function properly. They discuss how PQC failure leads to disease conditions. They also dwell upon using the system to therapeutics. The review by Wangeline *et al.* titled 'Proteostatic tactics in the strategy of sterol regulation' is also related to PQC, but with emphasis on metabolism, particularly sterol regulation. The possible clinical relevance of proteostasis in sterol biosynthesis is discussed.

The review by Legoux *et al.* deals with T cells reactive towards non-peptidic ligands. The authors define unconventional T cells and main features of preset T cells which are useful for non-immunologists. They then describe various aspects of preset T cells in detail.

The review by Marioni and Arendt is entitled 'How single cell genomics is changing evolutionary and developmental biology'. The title effectively describes the content of the review. The section 'Technological and computational state of the art' describes how large data are generated. The authors then describe aspects of lineage and evolution of cell types. The section on challenges is particularly useful as technical problems related to generation and interpretation of high-throughput data are outlined. Whittaker and Dean review 'The FLC locus: a platform for discoveries in epigenetics and adaption'. They describe the

biology related to *Arabidopsis thaliana* FLOWERING LOCUS c (FLC). The rather catchy section titles such as 'Don't be frightened', 'A breath of (COOL) AIR', 'Frozen in time' and 'Let's get physical' describe the contents aptly. The authors point out the relevance of extensive studies on FLC to those on epigenetic variation in the content of adaption and evolution.

The review by Flanagan *et al.* deals with vaccination and is entitled 'Sex and gender differences in the outcomes of vaccination over the life course'. The review also covers mechanisms mediating sex differences in vaccine response and efficacy, and mechanisms mediating gender differences in vaccines. What emerges from the review is that vaccine efficacy would differ in males and females; it also highlights the importance of microbiota. It is a must read for researchers working in the area of vaccines.

In summary, the figures and tables give an excellent overview of the contents in the reviews, as in the earlier ones. In this volume, several areas that have been extensively studied over the years have been reviewed. Questions that still remain to be answered are highlighted. It is evident that model organisms such as *Drosophila* and *Arabidopsis* can still provide important insights into various aspects of cell and developmental biology. This volume is a must read for 'young' and 'old' investigators.

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