

Annual Review of Microbiology, 2018. Susan Gottesman, Caroline S. Harwood and Olaf Schneewind (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 72. xiv + 553 pages. Price: US\$ 112.

The present volume of *Annual Review of Microbiology* has kept with the high tradition of publications in this series of the books. The volume begins with a tribute to the three giants in the field, Charles Yanofsky, Allan Campbell and Stanley Falkow, who passed away recently. These legendary scientists provided us with many of the basic concepts in molecular biology/genetics and bacterial pathogenesis.

The first article (A life in science) is by Volkmar Braun, who talks of his journey into membrane research. He recalls how the demonstration of simple experiment on distillation of organics from sawdust molded his interest in chemistry. One should not hesitate or be deterred by 'impossibles' in science. The article is an account of how his own research moved from characterizing the lipoprotein components of *Escherichia coli* outer membrane to characterizing the iron receptors and the import of proteinaceous toxins, and the connections between the two. The research offers attractive targets for the development of new antibacterials. The next article by Daniel-Ivad *et al.* talks about the importance of small (secondary) metabolites produced by large gene clusters in bacteria (e.g. polyketides and small nonribosomal proteins from streptomycetes). Many of them are used as drugs for various ailments. The authors discuss the regulatory mechanisms of these specialized metabolism. How the chemical signals and signal transduction control the specialized metabolism and what the mechanisms of strain-strain interaction are, remain important to study.

The article by Seifert sums up the biologically important roles (including in diseases) of the guanine quadruplex (G4) structures. These structures in DNA or RNA or DNA/RNA hybrids are of physiological importance (including in the viruses of eukaryotic and prokaryotic origin). This article is then followed by an article by Lang and Merrih on the replication-transcription conflicts. The bacterial systems have allowed for a

better understanding of the phenomenon. The replication/transcription conflict affects not only these fundamental processes but also the aspects of mutagenesis and evolution. The article discusses the current status of our understanding on how these conflicts are resolved and the differences in the nonsynonymous mutations that occur in the genes that are transcribed in an orientation leading to a 'head on' collision between the replication and the transcription machineries. As we speak of mutations, Roux and Blokesch discuss the role of horizontal gene transfer (HGT) and mutations in *Vibrios* as the major mechanism to adapt to new ecological environments for both the pathogenic and nonpathogenic strains. The next article is by Wall, Majdalani and the editor herself. They describe how Rcs (regulation of capsular polysaccharide synthesis), a complex variation on the two component system regulatory cascade, positively regulates capsule polysaccharide synthesis and how the synthesis of RprA, a small RNA (sRNA) negatively regulates motility. The success of commensal *E. coli* and biofilm formation is also dependent on regulated expression of Rcs. Interestingly, loss of some components of Rcs helps colonization of *Yersinia pestis* in flea. Loss of Rcs components in other bacteria has also resulted in evolution of specific properties on them. The subsequent chapter by Carrier *et al.* talks about the ever-expanding roles of sRNAs in bacteria. The sRNA (~50–500 nucleotides long) based regulation can rapidly change bacterial physiology by both the *cis* (also called antisense, *as*) and *trans* acting (*ta*) RNAs. The interactions of *as*sRNA and *ta*sRNA can result in different outcomes. The activities of sRNAs, in general, depend on their interaction with Hfq. The next article by Gourse *et al.* provides an update on the role of (p)pGpp in stringent response. The article talks about DksA, a transcription factor that binds to RNA polymerase. Often it has been difficult to mimic *in vivo* function ppGpp based regulation of transcription *in vitro*. However, when investigated together with DksA, even *in vitro*, as much as 20 fold decrease in transcription of rRNA genes can be observed. It is difficult to define DNA structures/sequences signatures for ppGpp-based gene regulation. The evolution of antibiotic resistance is a major concern. The article by Vázquez-Laslop

and Mankin talks about the context-dependent inhibition by antibiotics. They emphasize on the power of modern tools to study context-specific roles of antibiotics in inhibition of protein synthesis. Better knowledge of inhibitory mechanisms must help in designing better antibiotics to overcome the problem of antimicrobial resistance (AMR). The subsequent article by Blázquez *et al.* highlights the mechanisms that lead to developing antibiotic resistance (especially at the subinhibitory concentrations) through mutations and selection, and how it may be possibly prevented. In fact, development of antibiotic resistance seems an unavoidable consequence of their use, which leads to production of reactive oxygen species and induction of stress response. Inhibition of conjugation process to avoid HGT, and that of the stress response mediated mutagenesis might be appealing mechanisms to prevent development of AMR. For cell to cell communication, bacteria secrete molecules into the exterior environment or even directly inject them into other cells. The secretory processes are affected by various secretory systems whose understanding has remained difficult. The article by Rapisarda *et al.* talks about the utility of the new and improved Cryo-EM methods in characterization of the bacterial secretory systems. A newer concept on the role of liquid-liquid separation for the biological functions has then been discussed by Langdon and Gladfelter. Partitioning of mRNAs into liquid droplets in such a phenomenon by interaction with the RNA binding proteins allows for their compartmentalization within the cytosol in the absence of membranous structures. The mRNAs must become accessible for use when needed for regulation of gene expression in time and space.

Is a vaccine for malaria on the horizon? Read about it in the article by Laurens who discusses on the phase 3 clinical trial in Africa on an RTS,S vaccine candidate (a recombinant protein-based vaccine). He talks about the challenges and the progress/status of many vaccine candidates. He discusses on targeting various stages of the parasite life cycle for vaccine development. The combination of vaccines and other interventions may lead to eventual elimination of the disease. The next article by Bloomfield talks about the life cycle of social amoeba (dictyostelids) and meiosis in them. These

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organisms provide a basis for Spo11 (an endonuclease that introduces double stranded breaks in DNA) independent form of meiosis in the diploid macrocyst. The Spo11 independent meiotic recombination may use an additional topoisomerase II.

The article by Dolan and Welch provides a good account of the glyoxylate shunt pathway. The article talks about the crucial regulatory events that take place in organisms at the bifurcation point for glyoxylate shunt/TCA cycle, and how the enzymes (ICL and ICD) at the branch point through post-translational modifications and allosteric regulations function in different organisms. The next article by Müller *et al.* talks about flavin based electron bifurcation (FBEB), a phenomenon that allows generation of reduced ferredoxin (Fd_{red}) using H_2 or NADH as the reducing agents. FBEB is important in energy metabolism in anaerobic organisms, and in our understanding of how it helps in promoting endergonic reactions (in fact, more efficiently than ATP). The phenomenon of FBEB might have served important function during the course of evolution.

In yet another article on malarial parasite by Duraisingh and Skillman, we learn about the epigenetic changes that occur in the parasite chromatin that are associated with gene silencing/activation and key processes to facilitate transition of the parasite through various stages of its life cycle. Likewise, a little later in the book, the article by Kim addresses the epigenetic regulation of the various stages in the life cycle of *Toxoplasma*.

The article by Feurtey and Stukenbrock talks about how the next generation sequencing of >800 fungal genomes has been helping in our understanding of gene exchange in fungi, and the mechanism of their rapid evolution, especially the pathogenic fungi. The authors discuss the mechanisms of gene exchange and their relevance in adaptive evolution as also their importance in fungal biodiversity. The article by Ost and Round discusses the cross talk between our immune system and the commensal microbiota (and the metabolites they produce) in our body. The immune system needs to interact with the microbiota to prevent infection/invasion but at the same time not to evoke a detrimental response. The authors talk about the various cell types involved in this interaction. The immunomodulation by the

commensals can also indirectly modulate the host immune response to the surrounding organisms. The Ebola virus caused serious epidemic in West Africa in 2013–14 wherein ~30,000 cases of infection resulted in ~11,000 deaths. The chapter by Feldmann *et al.* discusses on the knowledge gained from human trials of the fast-tracked vaccine candidates (even though they did not have a major impact on the epidemic). Our innate immune system recognizes the bacterial pathogens using the pattern recognition receptors (PRR). The article by Tan *et al.* talks about how the host evokes self-defense following recognition of the pathogen's DNA/RNA by its receptors (PRR) by triggering production of interferons and proinflammatory reactions to generate antimicrobial response; and how the microbes overcome the host reactions. The authors focus on the mechanism of how the host recognizes the pathogen's DNA/RNA.

The gamete forms of the malarial parasite are taken up by the mosquito during its blood meal. The article by Josling *et al.* talks about the importance of the step of development of the gametes in the parasite following the asexual blood stage, for therapeutic intervention of malaria. The authors highlight the recent developments in the differentiation process leading to gametogenesis to provide a stronger basis for gene regulatory mechanism during gametogenesis. The last (but not the least) article in the book by Croucher *et al.* is devoted to pneumococcal vaccines. *Streptococcus pneumoniae* is an obligate commensal of the mucosal surface in nasopharynx (upper respiratory tract). However, its migration into the middle ear, lower respiratory tract and eyes can lead to severe disease consequences. The article discusses about the vaccine design, its interactions with the host and the population dynamics.

Finally, I must say that I enjoyed reading through the book. The articles are appropriately sized and sweet. English, in just a few of the articles, is a bit difficult to follow but they are prepared in a style that allows one to read them to a self-determined depth to provide a lasting impact of the topic. The book will most certainly serve as a reference to prepare for the teaching material as also to develop an in-depth knowledge of the various topics. The editors and the authors of all the articles (24 in all) have

done a remarkable job in producing this work of art in science. I highly recommend it to the students and the researchers alike.

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Annual Review of Astronomy and Astrophysics, 2018. S. M. Faber and Ewine van Dishoeck (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 56. xiv + 724 pages. Price: US\$ 112.

Every year the community of astrophysicists looks forward to this volume of reviews that informs them of the current state of research in a few select fields. These reviews not only try to find the important threads of research in the past years or decades, but often also set the tone for future research in these fields. This makes them valuable not only for the beginners, who may want to familiarize themselves with the past works, but also for the active practitioners, for new insights and ideas for further research. In addition, every volume comes with a memoir of a well-known astrophysicist, whose story of research serves as a resource material for historians, and inspiration for young astronomers.

The review volume for 2018 begins with a memoir by Jaan Einasto, a cosmologist who did most of his research in Estonia. His account gives a rare glimpse into the astrophysical community in the erstwhile USSR, during the height of the cold war. It is interesting to read how scientists there had often thought and worked on ideas that became fashionable in the West later on, but whose names are not remembered in the annals of science because their papers were published in Russian journals. The figure of Yakov Zel'dovich naturally occupies a central place in the narrative, and Einasto describes a number of radical shifts in the cosmological ideas during this era, from the introduction of dark matter, to the cosmic web of structure formation.