

BOOK REVIEWS

Annual Review of Microbiology, 2015. Susan Gottesman, Caroline S. Harwood and Olaf Schneewind (eds). Annual Reviews, 4139 El Camino Way, PO Box 10139, Palo Alto, California 94303-0139, USA. Vol. 69, xii + 551 pp. Price: US\$ 99.

The 69th volume of *Annual Review of Microbiology (ARM)* highlights major advancements in the field of microbiology. One of the important themes in the book explores the role of microbial diversity in the healthy and disease states of the host. The chapter titled 'The pyromaniac inside you: *salmonella* metabolism in the host gut' explains how inflammation-derived nutrients facilitate colonization of *Salmonella* species and its influences on host metabolic pathways. Chapter titled 'The gut microbiota of termites: digesting the diversity in the light of ecology and evolution' explains how gut microbial diversity in termite dictates its ability to digest specific carbohydrate substrates, and how such substrate specificity has shaped the evolution and adaptation of termites. Chapter on 'Microbiology meets big data: the case of gut microbiota-derived trimethylamine' explains how the implementation of next-generation techniques (meta-OMICS) has facilitated discoveries of small metabolites. These are generated by a complex interaction between host and microbe metabolic pathways. The authors also argue that such discoveries not only help us decipher the molecular pathways that are involved in host-microbe crosstalk, but also provide invaluable insight into disease progression in the host. Chapter titled 'Mechanisms of bacterial colonization of the respiratory tract' explains the role of colonized microbial species in the lungs and how it influences the disease etiopathogenesis. *Clostridium difficile* is one of the main causes of hospital-acquired infection, Chapter titled 'Interactions between the gastrointestinal microbiome and *Clostridium difficile*' explains how antibiotic treatment reduces gut microbial diversity and allows colonization of opportunistic pathogens. The authors explain how *C. difficile* seizes this opportunity by interacting with host gut-metabolite to allow spore germination and toxin production. Microbial pathogens often utilize biofilm formation as one of the mechanisms to survive under

antibiotic stress. Chapter titled '*Candida albicans* biofilms and human disease' explains how one of the dominant fungal species forms a biofilm across different areas of the host and explains its implication in disease pathogenesis.

This book focuses on two aspects of bacterial transcription: (a) regulation of RNA polymerase-driven transcript elongation; and (b) role of transcription factors as a reactive oxygen species (ROS) quenchers. Chapter titled 'Regulation of transcript elongation' explains the molecular mechanism underlying the different aspects of transcription such as RNA polymerase-mediated transcription elongation, pausing and termination. The authors also summarize how RNA polymerase communicates/interacts with the ribosome to translate genetic information into protein with high efficiency and fidelity. ROS generated during cellular metabolic processes pose an eminent threat to cell survival. The chapter titled 'Transcription factors that defend bacteria against reactive oxygen species' describes the unusual role of transcription factors such as SoxR or OxyR, and demonstrates how they help the cell to sense the amount ROS and remove them by allowing expression of specific proteins.

The chapter titled 'How is Fe-S cluster formation regulated?' explains how a key component of the cellular machinery has been conserved under selection pressure across species. Iron remains one of the critical factors in cellular and molecular metabolism of microbes. Chapter titled 'Perception and homeostatic control of iron in the rhizobia and related bacteria' explains how iron homeostasis allows bacteria to maintain a symbiotic relationship with the host.

The mechanism underlying thymineless death (TLD) in bacterial cell death remains a challenging question for researchers. The chapter titled 'Thymineless death lives on: new insights into a classic phenomenon' explains the historical and current perspectives on TLD in bacteria. In eukaryotic systems, genetic alteration using CRISPR-Cas methodology has become an invaluable tool. However, limited breakthrough has been made in the bacterial system to utilize this methodology. Chapter titled 'CRISPR-Cas: new tools for genetic manipulations from bacterial immunity systems' explains the enzymes/proteins encoded by CRISPR-Cas loci in bacteria. The authors also provide detailed

mechanistic insight into the role of proteins that protect the genome against non-homologous genetic material, and explain how such methodology can be used to silence genes in bacteria. Another interesting chapter titled 'Stochastic switching of cell fate in microbes', argues that stochasticity of gene expression in bacteria results in the evolution of pathogenic species under selection pressure (antibiotics, starvation or oxidative). The authors also highlight the utility of microfluidics channels coupled with fluorescence imaging technology in capturing genotypic and phenotypic variation in microbes at single-cell level.

Mechanical forces that have shaped the internal and external organization of bacterial cells are poorly understood by biologists. A chapter titled 'Physics of intracellular organization in bacteria' explains the underlying physical forces that dictate the shape and organization in simple language. The authors also explain how intertwined physical and chemical forces dictate cellular and molecular processes inside the cell.

Mycobacterium remains a major threat to our society as it results in millions of deaths every year around the world. In India, the threat is even bigger and mostly under-represented in majority of surveys due to poor diagnosis and medical reporting. The need of the hour is to identify biomolecules that can be used as markers for rapid diagnosis as well as targets for therapeutic intervention. Chapter titled 'Assembly of the mycobacterial cell wall' explores such avenue and focus on identifying novel targets that are involved in bacterial cell-wall biogenesis. The authors also provide a comprehensive review on the advancements that have been made by researchers across the world. Proteasomes are critical components of the host cellular machinery and play an important role in a range of processes, including amino acid recycling and microbial pathogenesis. The chapter titled 'Bacterial proteasomes' explores the evolution of proteasome complex across species and explains how selection pressure (different environmental conditions) has influenced the modification/alteration in a complex assembly.

Minimal essential genome in endosymbionts has evolved by losing out non-essential genes, retaining bare minimal genes and acquiring the essential genes via horizontal gene transfer. The

chapter titled 'Microsporidia: eukaryotic intracellular parasites shaped by gene loss and horizontal gene transfers' explains how the microsporidian genome has evolved and its implication in cellular pathogenesis under selection pressure. *Bacillus anthracis* is an etiological agent of anthrax that results in disease among livestock and has the potential to pose a threat on human health. Anthrax toxin comprises protective antigen (PA), edema factor (EF) and lethal factor (LF), and association of PA with either LF or EF which determine the mode of pathogenesis. The chapter titled 'Anthrax pathogenesis' summarizes the results from various studies to provide insights into the mechanism underlying anthrax pathogenesis.

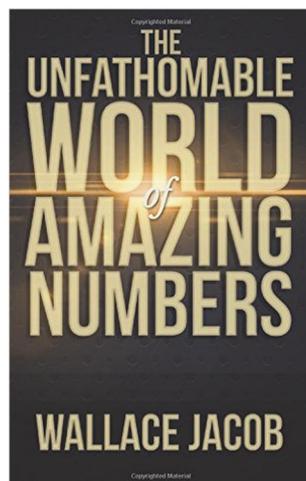
Septins play an important role in asymmetric division, the chapter titled 'Septins and generation of asymmetries in fungal cells' explains the mechanisms and processes underlying septin-mediated polar growth in fungi. The chapter titled 'Lytic cycle of *Toxoplasma gondii*: 15 Years Later' provides an overview of research that has evolved in the last decade or so to explain lytic cycle of parasites.

Plasmodium results in human death and remains a major burden on social healthcare systems across the world. To achieve a better and rapid diagnosis or discovery of novel drug targets, it is imperative to decipher the parasite life cycle inside the host post-infection. Chapter titled 'Ion regulation in the malaria parasite' explores that how sodium and potassium ion homeostasis across the erythrocyte cell wall is altered post-invasion.

Pore-forming toxins assemble large beta-barrel pores on the target membrane; however, how such a large assembly is facilitated with such efficiency remains a challenging question. The chapter titled 'The unique molecular choreography of giant pore formation by the cholesterol-dependent cytolysins of gram-positive bacteria' explains the mechanism underlying cholesterol-dependent pore formation by cytolysins.

MOHAN C. JOSHI

*Multidisciplinary Centre for Advance
Research and Studies,
Jamia Millia Islamia,
New Delhi 110 025, India
e-mail: mjoshi@jmi.ac.in*



The Unfathomable World of Amazing Numbers. Wallace Jacob. Notion Press, Chennai, 2014. xx + 354 pp, Price: Rs 345. ISBN: 9789384391324.

What is special about the numbers 23, 27, 37, 47, 751, 2519, 11,826, 37,037, 1,741,725, 1,274,953,680, 8,549,176,320, 36,085,288,503,684,007,860? Can the Fibonacci series be used for converting miles to kilometres? Is there any relationship between the terms of the Fibonacci series and Pythagorean triplets? Who coined the terms googol and googolplex? Which is the smallest positive number (>1) which can be expressed as a first power, second power, third power, fourth power, fifth power, sixth power, seventh power, eighth power and ninth power? What is meant by aliquot sum of an integer? Can we find the greater of the two numbers 31^{11} and 17^{14} without actually computing the values of 31^{11} and 17^{14} ? Can we determine the unit's digit of $3^{2001} - 2^{2001}$ without computing the values of 3^{2001} and 2^{2001} ? What are Diophantine equations? What is the significance of e (also known as Euler's number or Naper's constant) in the real world (in fact, 7 February is celebrated as the e -day)? The tome under review contains well-researched and elaborated answers to the aforementioned questions.

The book is a mesmerizing three-leg odyssey which provides interesting and novel learnings. Part A of the book explores the properties of 76 interesting numbers. Part B contains 54 mind-rattling puzzles and Part C dwells on a few esoteric concepts which have been simplified. The book can be helpful in developing a mathematical temperament. In fact, a person does not need be a

mathematics expert in order to understand the concepts explained in the book. It explains the properties of numbers as small as 6 and as large as 31,415,926,535,897,932,384,626,433,832,795,028,841.

The book dwells on Fibonacci numbers, Tribonacci series, Lucas series, Tetranacci series, special numbers such as narcissistic numbers, Armstrong numbers, Filzian numbers, factorion, sphenic numbers, pronic numbers, Leyland number, Lucas-Carmichael number, automorphic numbers, trimorphic numbers, amicable numbers, triangular numbers, etc.

In the domain of prime numbers alone, the book dissects emirp, primorial numbers, father prime, Sophie Germain prime, prime quadruplet, prime quintuplet, prime sextuplet, Wilson prime, Weiferich prime, Woodall prime, Euclid-Mullin sequence, pi-prime, circular prime numbers, palindromic prime number, interprime numbers, twin primes, Fermat primes, Mersenne primes, prime triplets, left-truncatable primes, right-truncatable primes, two-sided primes, permutable primes, titanic primes, gigantic primes, megaprimes and Cullen primes.

Some questions which have been solved in the book are indeed lengthy. Part B has ten solved questions on cryptarithms. The solution to one of the questions on cryptarithms is worked out on approximately 11 pages (pp. 159–169). A question based on an equation has been solved over about 90 pages (pp. 176–263). Needless to say, the question has been examined from three different perspectives.

Approximately 22 pages in the book have been devoted to the concepts of magic squares. The book provides a step-by-step visual explanation of constructing a magic square of odd-order as well as of even-order. It also provides information on alphamagic squares, templar magic squares, Concentric or bordered magic squares, antimagic squares and Ramanujan's magic square. In the domain of Pythagorean triplets, the author has listed methods of generating Pythagorean triplets using two odd integers which differ by 2, two even integers which differ by 2, and two fractions or whole numbers whose product is 2. The book also enlists Euclid's and Plato's methods of generating Pythagorean triplets. The concept of leap year (also known as intercalary year) has been discussed in great detail (pp. 303–304).